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Supporting Data FY 2004/2005 President's Budget
Submitted to OSD – February 2003

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

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**DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS
OF THE
RESEARCH, DEVELOPMENT, TEST AND
EVALUATION, ARMY
FY 2004/2005
PRESIDENT'S BUDGET SUBMISSION
FEBRUARY 2003**

**VOLUME I
Budget Activities 1, 2 and 3**

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

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**FY 2004/2005 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) and R-3 (Army RDT&E Cost Analysis) Exhibits, which provide narrative information on all RDT&E program elements and projects for FY 2002 through FY2005.

2. Relationship of the FY 2004/2005 Budget Submission to the FY 2003 Budget Submitted to Congress. This paragraph provides a list of program elements restructured, transitioned, or established to provide specific program identification.

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

OLD		NEW
<u>PE/PROJECT</u>	<u>NEW PROJECT TITLE</u>	<u>PE/PROJECT</u>
0601103D	University Research Initiative	0601103A/D55
0602720A/F25	Pollution Prevention	0602720A/895
0603004A/43A	Advanced Munitions Demonstration	0603004A/232
0603006A/592	High Altitude Airship ACTD	0603006A/588
0603238A/177	Joint Virtual Battlespace	0603015A/S30
0603001A/545	Force Projection Logistics	0603015A/S31
0603104D	Explosives Demil Tech	0603103A/D51
0603734A/T08	Base Camp Protection	0603125A/DF1
0603308A/99A	Army SIAP Systems Engineering	0603327A/S24
0603305A/TR4	Army SIAP Operational Integration	0603327A/S25
0603305A/TR6	Joint Distributed Engineering Plant (JDEP)	0603327A/S27
0603879N	Joint SIAP System Engineering	0603327A/S32
0603006A/592	Overwatch ACTD	0603710A/590

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0603711BR	Nuclear Arms Control Tech – Sensor & Network Mon	0603782A/F98
0603801A/B33	Adv Maint Concepts/EQ	0603801A/B32
0603869C	Medium Extended Air Defense System (MEADS)	0603869A/01B
BA0510	Ground CID (BCIS)	0604817A/482
0604818A/C12	Standard Integrated Command Posts (SICPS)	0604818A/C39
0605605A	Big Crow Support	0605601A/F38
0603858D	Unexploded Ordnance Clearance Technology Spt	0605857A/06H
0303140A/491	Army Common Access Card/Public Key Infrastructure	0303140A/50B
0305204A/114	Extended Range UAV (JMIP)	0305204A/D09
0305208A/956	DCGS-A Sensor Integration (JMIP)	0305208A/D08
0305208A/956	DCGS-A Common Modules (JMIP)	0305208A/D07
0604321A/B19	DCGS-A ASAS Integration (JMIP)	0305208A/D06
0708045A/E27	MFG Science and Technology	0708045A/E25

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

FROM		TO
<u>PE/PROJECT</u>	<u>PROJECT TITLE</u>	<u>PE/PROJECT</u>
0602308A/D02	Institute for Creative Technology (ICT)	0603015A/S28
0602308A/C90	Modeling & Simulation	0603015A/S29
0602308A/C90	RDEC Federation	0603015A/S31
0602303A/214	Advanced Missile Demonstration	0603313A/704
0603607A/627	Adv Crew Svc Wpn	0604601A/033
0603854A/F47	Objective Force Indirect Fires	0604645A/F50
0603802A/AS3	Obj Ind Cbt Wpn Eng Dev	0604802A/134
0603009A/B34	Z02	0203806A/Z02

C. Establishment of New FY 2004/2005 Program Elements/Projects. There are no major system new starts. Minor new initiatives for FY 2004/2005 are shown below with asterisks. The remaining programs listed are outyear initiatives, restructures beyond FY 2004/2005, or were previously funded from other Defense appropriations.

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<u>TITLE</u>	<u>PE/PROJECT</u>
National Aerospace Initiative*	0602303A/G02*
AC60*	0602786A/C60*
High Energy Laser Technology Demo	0603004A/L96
DB96*	0603020A/B96*
National Aerospace Initiative – Adv Dev*	0603313A/G03*
Smoke/Obscurant System*	0603627A/E79*
Comanche Companion UAV	0604223A/C79
Trailer Development*	0604622A/E50*
Army Tactical Missile System – Penetrator*	0604768A/MD6*
NAVSTAR GPS Equip*	0604778A/168*
Maintenance Support Equipment*	0604804A/L46*
Surf Lnch Adv Med Rng Air-to-Air Msl (SLAMRAAM)*	0604802A/S23*
DTSP Development (JMIP)*	0305204A/11B*
MLRS Smart Tactical Rocket*	0603778A/783*
HIMARS P3I	0603778A/787

D. FY 2004/2005 programs for which funding existed in the FY 2003 Amended President’s Budget Submit (July 2002), but which are no longer funded beginning in FY 2004.

<u>PE/PROJECT</u>	<u>TITLE</u>	<u>BRIEF EXPLANATION</u>
0602308A/D03	JMASS	Program Terminated
0604619A/088	Wide Area Mine Engineering Development	Program Terminated
0604738A/J11	Alliance Executive Development & Integration	Program Terminated
0604746A/L66	Embedded Diagnostics/Prognostics Dev	Program Completed
0604768A/687	BAT P3I	Program Terminated
0604768A/2NT	BAT Operational Test	Program Terminated
0303028A/H13	Information Dominance Center (IDC)	Program Terminated

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

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* 0203735A/C64	0602601A/C84	0603020A/B77/B84/B85/B96
0203806A	0602786A/C60	0603322A/B92
0203808A/E11	0603005A/C66	0603710A/C65/C67
0301359A	0603009A/B18/B31/B34	0603851A/C75
0602122A/B72/622	0603017A/B69	0604328A/C71

*Funding ends in FY02

4. Comprehensive Program Review. This year, the Administration undertook a comprehensive review of 20% of the programs of the Executive Branch, including the same portion of programs within the Department of Defense. The Basic Research programs of the Department were reviewed as a whole, including Basic Research programs of the Army. The Basic Research program merited a rating of "Effective". A summary sheet describing the rating from the Basic Research evaluation follows.

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Department of the Army
FY 2004 RDT&E Program

Exhibit R-1

Summary

03-Feb-2003

Summary Recap of Budget Activities	Thousands of Dollars			
	FY 2002	FY 2003	FY 2004	FY 2005
Basic research	220,960	244,411	343,037	344,398
Applied Research	865,270	857,766	641,263	654,784
Advanced technology development	906,920	1,040,392	805,696	829,188
Advanced Component Development and Prototypes	859,300	856,512	784,347	694,361
System Development and Demonstration	2,141,017	2,512,282	4,737,771	5,243,019
Management support	928,420	950,090	860,457	872,978
Operational system development	1,096,365	1,073,396	950,254	899,963
Total RDT&E, Army	7,018,252	7,534,849	9,122,825	9,538,691

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 Department of the Army
 FY 2004 RDT&E Program

Exhibit R-1

03-Feb-2003

Appropriation: 2040 A RDT&E, Army

Line No	Program Element Number	Act	Item	Thousands of Dollars			
				FY 2002	FY 2003	FY 2004	FY 2005
Basic research							
1	0601101A	01	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	13,726	20,608	24,121	24,256
2	0601102A	01	DEFENSE RESEARCH SCIENCES	135,535	140,493	128,798	129,586
3	0601103A	01	UNIVERSITY RESEARCH SCIENCES (H)	0	0	71,642	77,166
4	0601104A	01	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	71,699	83,310	84,816	79,750
5	0601105A	01	FORCE HEALTH PROTECTION	0	0	9,847	9,796
6	0601114A	01	DEFENSE EXPERIMENTAL PROGRAM TO STIMULATE COMPETIT	0	0	9,730	9,614
7	0601228A	01	HISTORICALLY BLACK COLLEGES AND UNIVERSITIES/MINOR	0	0	14,083	14,230
Total: Basic research				220,960	244,411	343,037	344,398
Applied Research							
8	0602105A	02	MATERIALS TECHNOLOGY	20,206	33,621	15,186	14,881
9	0602120A	02	SENSORS AND ELECTRONIC SURVIVABILITY	31,635	21,820	22,765	25,510
10	0602122A	02	TRACTOR HIP	7,197	8,006	5,835	6,097
11	0602211A	02	AVIATION TECHNOLOGY	41,295	39,693	39,459	41,886
12	0602270A	02	EW TECHNOLOGY	16,427	17,303	17,029	17,923
13	0602303A	02	MISSILE TECHNOLOGY	58,855	53,308	43,269	50,407
14	0602307A	02	ADVANCED WEAPONS TECHNOLOGY	25,460	19,976	14,189	17,560
15	0602308A	02	ADVANCED CONCEPTS AND SIMULATION	30,319	30,150	15,941	15,643
16	0602601A	02	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	109,394	79,952	80,910	71,108
17	0602618A	02	BALLISTICS TECHNOLOGY	60,646	62,458	53,478	52,392
18	0602622A	02	CHEMICAL, SMOKE AND EQUIPMENT DEFEATING TECHNOLOGY	6,079	15,643	3,540	3,553
19	0602623A	02	JOINT SERVICE SMALL ARMS PROGRAM	5,088	5,468	5,835	5,979
20	0602624A	02	WEAPONS AND MUNITIONS TECHNOLOGY	62,914	72,504	39,485	45,598
21	0602705A	02	ELECTRONICS AND ELECTRONIC DEVICES	48,000	59,682	33,694	42,005
22	0602709A	02	NIGHT VISION TECHNOLOGY	22,172	19,696	22,233	22,420
23	0602712A	02	COUNTERMINE SYSTEMS	21,995	16,857	21,291	21,422
24	0602716A	02	HUMAN FACTORS ENGINEERING TECHNOLOGY	20,144	20,516	16,749	16,357
25	0602720A	02	ENVIRONMENTAL QUALITY TECHNOLOGY	16,692	26,747	18,252	17,157

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Appropriation: 2040 A RDT&E, Army

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Line No	Program Element Number	Act	Item	Thousands of Dollars			
				FY 2002	FY 2003	FY 2004	FY 2005
26	0602782A	02	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	22,130	21,150	18,728	18,696
27	0602783A	02	COMPUTER AND SOFTWARE TECHNOLOGY	3,895	4,001	4,142	4,102
28	0602784A	02	MILITARY ENGINEERING TECHNOLOGY	56,911	55,304	45,407	46,034
29	0602785A	02	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	14,367	15,358	15,548	15,607
30	0602786A	02	LOGISTICS TECHNOLOGY	31,650	34,239	29,421	21,375
31	0602787A	02	MEDICAL TECHNOLOGY	122,121	124,314	58,877	61,072
32	0602805A	02	DUAL USE SCIENCE AND TECHNOLOGY	9,678	0	0	0
Total: Applied Research				865,270	857,766	641,263	654,784
Advanced technology development							
33	0603001A	03	WARFIGHTER ADVANCED TECHNOLOGY	59,815	57,014	63,882	68,763
34	0603002A	03	MEDICAL ADVANCED TECHNOLOGY	169,598	166,406	35,168	38,686
35	0603003A	03	AVIATION ADVANCED TECHNOLOGY	37,290	41,924	72,083	70,327
36	0603004A	03	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	34,244	63,230	47,752	72,404
37	0603005A	03	COMBAT VEHICLE AND AUTOMOTIVE ADVANCED TECHNOLOGY	220,196	264,795	210,856	205,245
38	0603006A	03	COMMAND, CONTROL, COMMUNICATIONS ADVANCED TECHNOLOGY	33,272	6,814	10,379	13,073
39	0603007A	03	MANPOWER, PERSONNEL AND TRAINING ADVANCED TECHNOLOGY	3,077	7,663	4,931	7,158
40	0603008A	03	ELECTRONIC WARFARE ADVANCED TECHNOLOGY	0	26,931	40,347	41,982
41	0603009A	03	TRACTOR HIKE	12,027	17,141	8,781	10,094
42	0603015A	03	NEXT GENERATION TRAINING & SIMULATION SYSTEMS	0	0	18,649	20,379
43	0603017A	03	TRACTOR RED	300	0	0	0
44	0603020A	03	TRACTOR ROSE	8,952	4,602	2,872	3,284
45	0603103A	03	EXPLOSIVE DEMILITARIZATION TECHNOLOGY	0	0	9,349	9,860
46	0603105A	03	MILITARY HIV RESEARCH	5,697	0	6,733	6,746
47	0603125A	03	COMBATING TERRORISM, TECHNOLOGY DEVELOPMENT FOR	0	41,842	4,916	3,436
48	0603238A	03	GLOBAL SURVEILLANCE/AIR DEFENSE/PRECISION STRIKE T	34,963	29,788	12,660	8,833
49	0603270A	03	EW TECHNOLOGY	23,537	18,756	11,273	9,213
50	0603313A	03	MISSILE AND ROCKET ADVANCED TECHNOLOGY	76,979	99,695	111,321	94,062
51	0603322A	03	TRACTOR CAGE	3,078	2,939	7,592	9,165
52	0603606A	03	LANDMINE WARFARE AND BARRIER ADVANCED TECHNOLOGY	24,718	28,595	24,552	25,476

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Line No	Program Element Number	Act	Item	Thousands of Dollars			
				FY 2002	FY 2003	FY 2004	FY 2005
53	0603607A	03	JOINT SERVICE SMALL ARMS PROGRAM	4,264	12,998	6,193	5,979
54	0603654A	03	LINE-OF-SIGHT TECHNOLOGY DEMONSTRATION	72,530	26,955	8,847	0
55	0603710A	03	NIGHT VISION ADVANCED TECHNOLOGY	54,913	73,609	47,088	54,635
56	0603728A	03	ENVIRONMENTAL QUALITY TECHNOLOGY DEMONSTRATIONS	7,026	12,846	15,776	14,897
57	0603734A	03	MILITARY ENGINEERING ADVANCED TECHNOLOGY	4,554	13,696	3,441	3,926
58	0603772A	03	ADVANCED TACTICAL COMPUTER SCIENCE AND SENSOR TECH	15,890	22,153	20,255	31,565
Total: Advanced technology development				906,920	1,040,392	805,696	829,188
Advanced Component Development and Prototypes							
59	0603305A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION	0	37,233	51,547	51,802
60	0603308A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION (DEM/VAL)	68,481	57,429	9,632	9,649
61	0603327A	04	AIR AND MISSILE DEFENSE SYSTEMS ENGINEERING	0	0	79,959	71,887
62	0603619A	04	LANDMINE WARFARE AND BARRIER - ADV DEV	20,300	9,716	36,976	42,262
63	0603627A	04	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ADV DEV	0	2,323	10,262	12,972
64	0603639A	04	TANK AND MEDIUM CALIBER AMMUNITION	52,252	26,492	11,249	1,943
65	0603653A	04	ADVANCED TANK ARMAMENT SYSTEM (ATAS)	98,145	143,296	61,377	52,429
66	0603747A	04	SOLDIER SUPPORT AND SURVIVABILITY	14,939	19,558	13,987	12,213
67	0603766A	04	TACTICAL SUPPORT DEVELOPMENT - ADV DEV (TIARA)	16,225	16,107	17,068	16,079
68	0603774A	04	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT	10,662	11,170	5,283	5,227
69	0603779A	04	ENVIRONMENTAL QUALITY TECHNOLOGY DEM/VAL	39,047	31,121	11,514	9,454
70	0603782A	04	WARFIGHTER INFORMATION NETWORK-TACTICAL - DEM/VAL	12,140	48,556	90,774	75,332
71	0603790A	04	NATO RESEARCH AND DEVELOPMENT	6,202	4,559	4,779	5,263
72	0603801A	04	AVIATION - ADV DEV	12,807	10,767	9,968	9,320
73	0603802A	04	WEAPONS AND MUNITIONS - ADV DEV	33,567	34,257	31,856	4,868
74	0603804A	04	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	7,412	9,243	12,008	10,713
75	0603805A	04	COMBAT SERVICE SUPPORT CONTROL SYSTEM EVALUATION A	8,395	8,415	8,682	8,658
76	0603807A	04	MEDICAL SYSTEMS - ADV DEV	19,270	13,340	11,042	10,012
77	0603850A	04	INTEGRATED BROADCAST SERVICE (JMIP/DISTP)	1,960	1,927	2,097	1,901
78	0603851A	04	TRACTOR CAGE (DEM/VAL)	3,566	0	0	0
79	0603854A	04	ARTILLERY SYSTEMS - DEM/VAL	427,273	356,651	0	0

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Appropriation: 2040 A RDT&E, Army

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Line No	Program Element Number	Act	Item	Thousands of Dollars			
				FY 2002	FY 2003	FY 2004	FY 2005
80	0603856A	04	SCAMP BLOCK II	6,657	14,352	28,028	15,107
81	0603869A	04	MEADS CONCEPTS - DEMVAL	0	0	276,259	267,270
Total: Advanced Component Development and Prototypes				859,300	856,512	784,347	694,361
System Development and Demonstration							
82	0604201A	05	AIRCRAFT AVIONICS	48,999	39,559	64,650	44,685
83	0604220A	05	ARMED, DEPLOYABLE OH-58D	1,764	1,790	0	0
84	0604223A	05	COMANCHE	754,381	874,018	1,079,257	1,181,563
85	0604270A	05	EW DEVELOPMENT	53,411	38,309	33,214	19,526
86	0604280A	05	JOINT TACTICAL RADIO SYSTEM	72,742	62,921	134,693	91,583
87	0604321A	05	ALL SOURCE ANALYSIS SYSTEM	44,242	54,366	20,168	15,548
88	0604328A	05	TRACTOR CAGE	4,967	9,309	16,215	15,147
89	0604329A	05	COMMON MISSILE	16,075	28,602	183,790	182,932
90	0604601A	05	INFANTRY SUPPORT WEAPONS	0	0	21,637	28,515
91	0604604A	05	MEDIUM TACTICAL VEHICLES	1,883	1,866	4,366	2,879
92	0604609A	05	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ENG DEV	7,611	7,654	12,094	4,223
93	0604611A	05	JAVELIN	2,870	467	956	952
94	0604619A	05	LANDMINE WARFARE	22,165	0	0	0
95	0604622A	05	FAMILY OF HEAVY TACTICAL VEHICLES	2,510	14,521	9,200	10,756
96	0604633A	05	AIR TRAFFIC CONTROL	1,116	2,199	2,514	2,596
97	0604641A	05	TACTICAL UNMANNED GROUND VEHICLE (TUGV)	1,439	1,146	0	0
98	0604642A	05	LIGHT TACTICAL WHEELED VEHICLES	1,920	7,531	15,700	10,022
99	0604645A	05	ARMORED SYSTEMS MODERNIZATION (ASM)-ENG. DEV.	0	239,213	1,701,331	2,458,373
100	0604649A	05	ENGINEER MOBILITY EQUIPMENT DEVELOPMENT	8,902	7,786	0	0
101	0604710A	05	NIGHT VISION SYSTEMS - ENG DEV	24,783	36,581	29,022	22,399
102	0604713A	05	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	90,579	86,449	67,283	66,748
103	0604715A	05	NON-SYSTEM TRAINING DEVICES - ENG DEV	29,010	56,002	71,616	62,634
104	0604716A	05	TERRAIN INFORMATION - ENG DEV	7,779	8,096	6,977	5,965
105	0604726A	05	INTEGRATED METEOROLOGICAL SUPPORT SYSTEM	1,899	3,361	3,309	3,300
106	0604738A	05	JSIMS CORE PROGRAM	29,758	19,213	0	0

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Department of the Army
FY 2004 RDT&E Program

Exhibit R-1

03-Feb-2003

Appropriation: 2040 A RDT&E, Army

Line No	Element Number	Program Act	Item	Thousands of Dollars			
				FY 2002	FY 2003	FY 2004	FY 2005
107	0604741A	05	AIR DEFENSE COMMAND, CONTROL AND INTEL - ENG	16,669	27,262	29,297	32,415
108	0604742A	05	CONSTRUCTIVE SIMULATION SYSTEMS DEVELOPMENT	64,279	43,813	16,994	1,155
109	0604746A	05	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	12,751	12,899	4,634	4,707
110	0604760A	05	DISTRIBUTIVE INTERACTIVE SIMULATIONS (DIS) - ENGIN	21,333	18,128	26,358	20,567
111	0604766A	05	TACTICAL EXPLOITATION SYSTEM/DCGS (TIARA)	59,668	57,255	19,695	16
112	0604768A	05	BRILLIANT ANTI-ARMOR SUBMUNITION (BAT)	106,860	42,942	55,075	9,836
113	0604770A	05	JOINT SURVEILLANCE/TARGET ATTACK RADAR SYSTEM	7,485	4,511	4,705	0
114	0604778A	05	POSITIONING SYSTEMS DEVELOPMENT (SPACE)	0	0	1,574	2,065
115	0604780A	05	COMBINED ARMS TACTICAL TRAINER (CATT)	11,799	8,247	3,998	5,596
116	0604783A	05	JOINT NETWORK MANAGEMENT SYSTEM	21,225	7,677	9,437	10,811
117	0604801A	05	AVIATION - ENG DEV	5,365	3,481	2,379	2,390
118	0604802A	05	WEAPONS AND MUNITIONS - ENG DEV	16,546	50,341	129,409	133,444
119	0604804A	05	LOGISTICS AND ENGINEER EQUIPMENT - ENG DEV	31,204	64,808	86,288	88,153
120	0604805A	05	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ENG DEV	112,970	89,546	219,088	162,970
121	0604807A	05	MEDICAL MATERIEL/MEDICAL BIOLOGICAL DEFENSE EQUIPM	17,070	18,790	12,202	11,715
122	0604808A	05	LANDMINE WARFARE/BARRIER - ENG DEV	55,502	123,314	90,396	90,126
123	0604814A	05	SENSE AND DESTROY ARMAMENT MISSILE - ENG DEV	59,329	102,188	133,994	153,389
124	0604817A	05	COMBAT IDENTIFICATION	2,892	4,985	3,541	0
125	0604818A	05	ARMY TACTICAL COMMAND & CONTROL HARDWARE & SOFTWARE	59,276	96,326	98,129	86,950
126	0604819A	05	LOSAT	24,773	13,597	30,809	22,610
127	0604820A	05	RADAR DEVELOPMENT	4,952	0	0	0
128	0604823A	05	FIREFINDER	25,875	24,913	27,107	28,515
129	0604854A	05	ARTILLERY SYSTEMS - EMD	63,655	26,614	32,629	9,636
130	0604865A	05	PATRIOT PAC-3 THEATER MISSILE DEFENSE ACQ - EMD	0	0	174,475	78,440
131	0605013A	05	INFORMATION TECHNOLOGY DEVELOPMENT	108,734	69,686	47,566	57,167
Total: System Development and Demonstration				2,141,017	2,512,282	4,737,771	5,243,019
Management support							
132	0604256A	06	THREAT SIMULATOR DEVELOPMENT	19,896	18,158	17,751	18,915
133	0604258A	06	TARGET SYSTEMS DEVELOPMENT	22,504	10,226	13,890	12,582

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 Department of the Army
 FY 2004 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

03-Feb-2003

Line No	Program Element Number	Act	Item	Thousands of Dollars			
				FY 2002	FY 2003	FY 2004	FY 2005
134	0604759A	06	MAJOR T&E INVESTMENT	47,304	51,168	62,135	66,524
135	0605103A	06	RAND ARROYO CENTER	19,467	21,172	22,804	23,016
136	0605301A	06	ARMY KWAJALEIN ATOLL	144,005	126,486	137,307	139,394
137	0605326A	06	CONCEPTS EXPERIMENTATION	30,678	23,564	26,473	27,121
138	0605502A	06	SMALL BUSINESS INNOVATIVE RESEARCH	160,561	178,120	0	0
139	0605601A	06	ARMY TEST RANGES AND FACILITIES	115,473	130,727	174,603	172,114
140	0605602A	06	ARMY TECHNICAL TEST INSTRUMENTATION AND TARGETS	35,560	41,052	54,986	60,018
141	0605604A	06	SURVIVABILITY/LETHALITY ANALYSIS	35,060	35,236	39,138	41,647
142	0605605A	06	DOD HIGH ENERGY LASER TEST FACILITY	22,445	16,679	17,806	17,999
143	0605606A	06	AIRCRAFT CERTIFICATION	3,524	3,618	3,098	3,132
144	0605702A	06	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	6,727	6,795	9,669	9,771
145	0605706A	06	MATERIEL SYSTEMS ANALYSIS	10,695	8,982	15,832	16,209
146	0605709A	06	EXPLOITATION OF FOREIGN ITEMS	3,381	3,431	3,579	5,465
147	0605712A	06	SUPPORT OF OPERATIONAL TESTING	85,714	91,566	67,795	67,757
148	0605716A	06	ARMY EVALUATION CENTER	29,763	37,923	57,074	57,404
149	0605718A	06	SIMULATION & MODELING FOR ACQ, RQTS, & TNG (SMART)	0	0	2,654	2,731
150	0605801A	06	PROGRAMWIDE ACTIVITIES	58,366	57,831	71,555	68,870
151	0605803A	06	TECHNICAL INFORMATION ACTIVITIES	41,695	45,516	28,520	28,929
152	0605805A	06	MUNITIONS STANDARDIZATION, EFFECTIVENESS AND SAFET	29,443	30,029	19,855	19,627
153	0605857A	06	ENVIRONMENTAL QUALITY TECHNOLOGY MANAGEMENT SPT	1,662	1,820	4,938	5,217
154	0605898A	06	MANAGEMENT HEADQUARTERS (RESEARCH AND DEVELOPMENT)	4,058	9,991	8,995	8,536
155	0909999A	06	FINANCING FOR CANCELLED ACCOUNT ADJUSTMENTS	439	0	0	0
Total: Management support				928,420	950,090	860,457	872,978
Operational system development							
156	0102419A	07	JOINT LAND ATTACK CRUISE MISSILES DEFENSE (JLENS)	31,114	28,792	57,549	56,420
157	0203610A	07	DOMESTIC PREPAREDNESS AGAINST WEAPONS OF MASS DEST	2,511	2,438	0	0
158	0203726A	07	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	35,716	44,978	28,917	22,551
159	0203735A	07	COMBAT VEHICLE IMPROVEMENT PROGRAMS	159,759	82,702	24,486	16,121
160	0203740A	07	MANEUVER CONTROL SYSTEM	40,231	42,229	39,581	17,883

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UNCLASSIFIED
Department of the Army
FY 2004 RDT&E Program

Exhibit R-1

03-Feb-2003

Appropriation: 2040 A RDT&E, Army

Line No	Program Element Number	Act	Item	Thousands of Dollars			
				FY 2002	FY 2003	FY 2004	FY 2005
161	0203744A	07	AIRCRAFT MODIFICATIONS/PRODUCT IMPROVEMENT PROGRAM	141,751	204,562	187,959	167,274
162	0203752A	07	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	14,443	6,767	3,399	3,451
163	0203758A	07	DIGITIZATION	31,420	32,158	18,251	18,716
164	0203759A	07	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW (FBCB2	54,927	61,961	48,436	20,224
165	0203761A	07	FORCE XXI WRAP	39	0	0	0
166	0203801A	07	MISSILE/AIR DEFENSE PRODUCT IMPROVEMENT PROGRAM	13,302	41,787	44,468	32,025
167	0203802A	07	OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS	52,921	12,445	9,822	4,915
168	0203806A	07	TRACTOR RUT	0	0	8,851	3,342
169	0203808A	07	TRACTOR CARD	11,081	8,499	9,255	9,118
170	0208010A	07	JOINT TACTICAL COMMUNICATIONS PROGRAM (TRI-TAC)	25,614	13,506	16,543	18,664
171	0208053A	07	JOINT TACTICAL GROUND SYSTEM	5,152	2,812	9,767	35,064
172	0301359A	07	SPECIAL ARMY PROGRAM	6,811	9,645	5,968	5,500
173	0303028A	07	SECURITY AND INTELLIGENCE ACTIVITIES	2,420	26,193	0	0
174	0303140A	07	INFORMATION SYSTEMS SECURITY PROGRAM	12,875	22,163	20,728	24,845
175	0303141A	07	GLOBAL COMBAT SUPPORT SYSTEM	79,012	49,360	58,983	65,158
176	0303142A	07	SATCOM GROUND ENVIRONMENT (SPACE)	43,059	68,915	87,352	64,538
177	0303150A	07	WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM	13,131	16,999	20,124	19,206
178	0305114A	07	TRAFFIC CONTROL, APPROACH AND LANDING SYSTEM-FY 19	753	935	956	1,903
179	0305204A	07	TACTICAL UNMANNED AERIAL VEHICLES	35,213	67,435	60,493	66,730
180	0305206A	07	AIRBORNE RECONNAISSANCE ADV DEVELOPMENT	10,910	11,438	4,751	5,094
181	0305208A	07	DISTRIBUTED COMMON GROUND SYSTEMS (JMIP)	71,836	44,823	32,292	42,377
182	0603778A	07	MLRS PRODUCT IMPROVEMENT PROGRAM	101,595	94,623	84,839	110,537
183	0708045A	07	END ITEM INDUSTRIAL PREPAREDNESS ACTIVITIES	98,769	74,728	65,981	67,706
184	1001018A	07	NATO JOINT STARS	0	503	503	601
Total: Operational system development				1,096,365	1,073,396	950,254	899,963
Total: RDT&E, Army				7,018,252	7,534,849	9,122,825	9,538,691

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7	0601228A	Historically Black Colleges and Universities/Minor	112
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8	0602105A	MATERIALS TECHNOLOGY	114
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16	0602601A	Combat Vehicle and Automotive Technology	178
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24	0602716A	HUMAN FACTORS ENGINEERING TECHNOLOGY	245
25	0602720A	Environmental Quality Technology	251
26	0602782A	Command, Control, Communications Technology	262
27	0602783A	COMPUTER AND SOFTWARE TECHNOLOGY	271
28	0602784A	MILITARY ENGINEERING TECHNOLOGY	275
29	0602785A	Manpower/Personnel/Training Technology	298
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31	0602787A	MEDICAL TECHNOLOGY	312
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56	0603728A	Environmental Quality Technology Demonstrations	476
57	0603734A	Military Engineering Advanced Technology	485
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LOGISTICS TECHNOLOGY	0602786A	30	301
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MEDICAL TECHNOLOGY	0602787A	31	312
Military Engineering Advanced Technology	0603734A	57	485
MILITARY ENGINEERING TECHNOLOGY	0602784A	28	275
MILITARY HIV RESEARCH	0603105A	46	425
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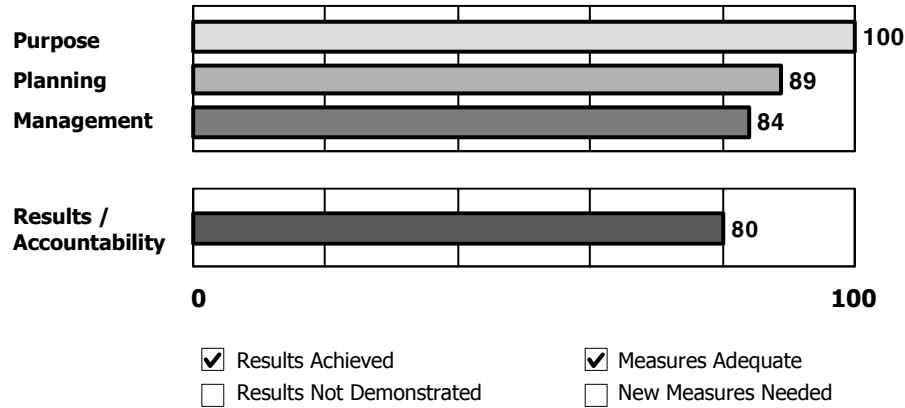
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Sensors and Electronic Survivability	0602120A	9	122
University and Industry Research Centers	0601104A	4	78
University Research Sciences (H)	0601103A	3	75
Warfighter Advanced Technology	0603001A	33	330
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Program: Basic Research

Agency: Department of Defense--Military

Bureau: Research, Development, Test, and Evaluation



Key Performance Measures

	Year	Target	Actual
Certification in biennial reviews by technically competent independent reviewers that the supported work, as a portfolio, is of high quality, serves to advance the national security and is efficiently managed and carried out.	2003 and later	100%	
Long-term Measure: Portion of funded research that is chosen on the basis of merit review Reduce non-merit-reviewed and -determined projects by one half in two years (from 6.0% to 3.0%)	2005	-50%	

Rating: Effective

Program Type: Research and Development

Program Summary:

The Basic Research program includes scientific study and experimentation to increase fundamental knowledge in the physical, engineering, environmental and life sciences and consists of a wide portfolio of projects. The program is carried out primarily through grants to universities and non-profits. The results of this research are expected to improve the country's defense capabilities, although the actual results of any specific project are unpredictable. Notable successes in the past have led to advances in satellite communications and imagery, precision navigation, stealth, night vision and technologies allowing greatly expanded battlefield awareness. Due to the long-term nature of research results, the R&D PART emphasizes assessment of the process of choosing funded projects and independent assessments of how well the research portfolio is managed.

The assessment indicates that the basic research program has clear purposes of providing options for new weapons systems, helping prevent technological surprise by adversaries, and developing new scientists who will contribute to the DoD mission in the future. DoD can document--through its contracts and grants management regulations, public announcements of award competitions and results from independent review panels--the methodical management of its program. Additional findings include:

1. The grants/contract solicitation, review and award processes are competitive.
2. The program is reviewed regularly by technically capable outside reviewers, which recommend improvements they would like to be implemented. They indicate that the work is of overall high quality.
3. The program has competent planning and management.
4. Earmarking of projects in the program has increased in the past decade and contribute less than the typical research project to meeting the agency's mission.

In response to these findings, the Administration will:

1. Continue to emphasize the use of independent review panels in assessing the performance of the program.
2. Work with the research community and Congress to explain the need to limit claims on research grant funds to proposals that independently can meet the standards of a strict merit-review process.

Program Funding Level (in millions of dollars)

<u>2002 Actual</u>	<u>2003 Estimate</u>	<u>2004 Estimate</u>
1,334	1,417	1,309

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	13726	20608	24121	24256	25384	25632	26246	17100
91A ILIR-AMC	9545	15748	18775	18890	19812	19973	20455	11178
91C ILIR-MED R&D CMD	3485	3658	3862	3897	4010	4086	4184	4278
91D ILIR-CORPS OF ENGR	696	1202	1484	1469	1562	1573	1607	1644

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 6.1 or 6.2 mission funding within an organization. The work in this program is performed by the Army Materiel Command, Army Medical Research and Materiel Command, the Army Corps of Engineers Engineer Research and Development Center and the Army Research Institute. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	14688	22998	26886	27271
Current Budget (FY 2004/2005 PB)	13726	20608	24121	24256
Total Adjustments	-962	-2390	-2765	-3015
Congressional program reductions		-1000		
Congressional rescissions		-793		
Congressional increases				
Reprogrammings	-666	-118		
SBIR/STTR Transfer	-296	-479		
Adjustments to Budget Years			-2765	-3015

Change Summary Explanation

Significant Changes:

FY04/05 - Funds realigned to increase investments in applied research and advanced technology major efforts.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601101A - In-House Laboratory Independent Research					PROJECT 91A			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
91A ILIR-AMC	9545	15748	18775	18890	19812	19973	20455	11178	

A. Mission Description and Budget Item Justification: This project provides funding for ILIR research in the Army Materiel Command's six Research, Development and Engineering Centers (RDECs) and the Army Research Institute. 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. Past and current ILIR efforts have had and are having significant impacts on technology development efforts supporting the Army Transformation to the Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The work in this program is performed by the Army Materiel Command. This program element contains no duplication with any effort within the Military Departments. This project supports the Objective transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds (DERF) were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91A

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Aviation and Missile RDEC Missile Efforts - In FY02, transitioned long shelf lifetime gel propellant technology to the Compact Kinetic Energy Missile (CKEM) development effort; validated and transitioned methods to reduce the propellant synthesis waste by 90%; transitioned analytical and Computational Fluid Dynamics models and new designs into current and future missile systems; validated improved heatshield designs for hypervelocity missiles nose cones, IR domes, and reduction of nozzle throat erosion. FY03 – Transition secure communications link based on chaotic waveform to Unmanned Ground Vehicle Project Office. Transition advanced Computational Fluid Dynamics models and designs into future hypersonic missile development programs. Transition protective coatings based on Photonic Band-Gap materials to applied technology programs of missile sensor protection from laser threats. Demonstrate in the laboratory a cost-effective three dimensional display. Establish a laboratory for the evaluation of ultra-short (femtosecond) pulsed laser radiation. FY04 – Evaluate the propagation characteristics of ultra-short pulsed laser radiation in realistic atmosphere. Demonstrate and quantify the damage characteristics of ultra-short pulse laser radiation to materials common to missile, aircraft, and UAV structure and components. Demonstrate techniques to predict and engineer the optical properties of materials to be used for laser-based optical communications and optical information technology. Demonstrate flat panel display technology capable of providing full frame rate, full resolution stereo viewing to the user and transfer this technology to advanced development programs. FY05 – Demonstrate at the laboratory breadboard level the fundamental operations of a quantum computer. Perform the necessary experiments and/or analysis to allow the transition of ultra-short pulse laser technology to appropriate applied technology programs.</p>	1667	3169	3272	3292

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91A

Accomplishments/Planned Program (continued)

- Armaments RDEC - FY02 - Investigated and evaluated biometrics for use in grip recognition for weapons and other applications to restrict usage to designated operators only; investigated multi-stage variable range compressed air propulsion for constant energy non-lethal projectile effects across tactical ranges; investigated computational modeling techniques to predict muzzle flash in cannons; interface with gun tube rifling in support of composite sabot application to rifled tube; investigated Low-Energy Variable Propulsion to tailor main propulsion combustion characteristics to achieve higher energy outputs; investigated structural, high energy composite materials to survive high- \hat{A} -g launch as well as provide additional energy to internal combustion to achieve higher velocities; investigated sonic rarefaction wave combustion venting in eliminating recoil force without degradation to projectile velocity. FY03: Conduct basic research in: higher/tailorable output energetics to include nanomaterial additives; synthesis of amino-Nitroimidazoles insensitive materials; reactive warhead liner materials; mechanical properties of energetics; nanotechnology enhanced energy density capacitance; biometric "grip recognition" to render weapons, grip control, "safe" from unwanted use; and sensitivity of eddy current non-destructive characterization of coatings. FY04: Conduct 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. FY05: Conduct basic research in energetics, smart munitions, armament materials, directed energy, and nanomaterials applied to armaments/munitions to achieve higher lethality on target, affordable increase in munitions accuracy, directed energy target effects.

FY 2002	FY 2003	FY 2004	FY 2005
1717	2320	3325	3346

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91A

Accomplishments/Planned Program (continued)

- Tank-automotive RDEC - FY02 - Developed warfighting requirements simulation models for advanced propulsion, non-linear multibody dynamics, signature management, and nontraditional materials to support development of vehicles for the Objective Force. In FY03, investigate terrain models for unmanned ground vehicle perception; design fuzzy logic and neural net control strategies for unmanned ground vehicles; develop and test engine combustion models and materials for laser eye protection; model and test composite materials; and test active and passive nonlinear suspensions. In FY04, develop fuzzy logic and neural net control strategies and terrain models for unmanned ground vehicle perception; continue development and testing of engine combustion models and materials for laser eye protection; modeling and testing of mechanisms for cooling vehicle electronics; and investigations into high speed ballistic impact imaging and modeling. In FY05, continue development and testing of fuzzy logic and neural net control strategies, terrain models, engine combustion models, and laser eye protection materials; and modeling and testing of high speed ballistic impacts.

FY 2002	FY 2003	FY 2004	FY 2005
1222	2268	2320	2335

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91A

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- Natick Soldier Center - FY02 - Evaluated nanomaterials for potential range uses in soldier survivability/sustainability equipment; modeled effects of air gaps in clothing on heat transfer to address protective clothing related heat stress reduction; visualized/quantified air mass trapped by a parafoil and applied to airdrop modeling/simulation; investigated polymerization of peptides for use as biosensors for integration with soldier clothing/individual equipment. FY03: Research promising nanomaterials for ballistic and chemical barrier performance improvements; perform 3D laser scanning of subscale personnel parafoil opening in Doriot Climatic Chambers to quantify added air mass effects generated during inflation; model and experimentally blend polymers containing tailored particulates to enhance bulk and fiber mechanical/durability properties for ballistic, chem/bio (CB) and airdrop applications; create new carbon nanotube-based composite materials with laser light blocking capability for laser eye and sensor protection; evaluate novel DNA detection technology as a method to uniquely and simultaneously identify biological warfare (BW) agents. FY04: Model new nanocomposites/arrays for use in improved ballistic/optical materials; perform biotechnology effort to identify protein biomarkers that correlate with warrior physiological status; develop mathematical model to predict effects of temperature and high pressure processing on antimicrobial activity in foods; investigate the effect of optical properties of military clothing as a means to improve thermal signature management and flame/thermal protection; create novel materials having variable porosity for parachute applications. FY05: Employ combinatorial chemistry to identify peptides capable of nucleating ceramic hard-faced materials for body armor; examine the use of proteomic methods for advanced biosensing; perform research on potential approaches to high accuracy, rapid screening for pathogens in food.</p>	650	1518	1631	1642
<p>- Edgewood Chemical Biological Center - FY02 - Developed an extractionless sample preparation process for the detection of BW agents. Began an examination of the molecular basis underlying the low-level toxicity of CW agents. Examined, for the first time, the temporal and thermal decay of a virus. Developed a head simulator for the assessment of new protective mask/helmet concepts. FY03-05 – Initiate research work on advanced obscurants, non-lethal agents and biotechnology applications to OFW. Initiate research to eventually develop a hand-held BW-aerosol detector. Begin synthesis of hardened enzymes (ureases) for the decontamination of CB agents. Initiate research to develop a high-throughput toxicity-assay for BW agents. Research on a process to detect soldier exposure to nerve agents under field conditions.</p>	1225	1832	2009	2020

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91A

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Aviation and Missile RDEC (AMRDEC) – Aviation. In FY02, conducted buildup of Background Oriented Stereoscopic Schlieren, Doppler Global Velocimetry, and Particle Imaging Velocimetry techniques for full-scale vortex and wake applications to improve rotor blade and airfoil performance. In FY03, conduct research and apply Stereoscopic Schlieren technique to a full-scale helicopter vortex model to improve rotor blade performance. Conduct low Reynolds number airfoil tests for Unmanned Aerial Vehicle (UAV) application. In FY04, investigate active on-blade control for a swashplate-less rotor concept. Perform research to develop semi-active control actuators for vibration control 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.	1578	2559	3050	3069
- Communications-Electronics RDEC - In FY02, evaluated concepts for new electronics materials for more powerful, reliable and lighter weight battlefield visualization tools, communications systems, power sources technology, and sensors. In FY03, investigate technologies: for prediction of the transport phenomenon of explosive-related chemicals (ERCs) as they are released from buried land mines, for enhanced target acquisition and identification, and for low altitude antenna communication using the Uniform Theory of Diffraction. In FY04, study and monitor ERC levels in surface soils over time and correlate air flux to surface soil ERC concentrations. Perform chemical evaluations to understand the basic solvent/ion interactions of new solutions for determining optimum composition for use in new Lithium Ion Batteries. Investigate a software engine that will convert natural language to a control language and then to eXtensible Mark-up Language (XML) for C2 applications. Investigate a very high order of encryption algorithm for communications networks. In FY05, investigate models for fused sensors and the development and training of automatic/aided target recognition algorithms. Identify techniques for practical Electrolyte development for Lithium Ion Batteries. Investigate phased array systems that will deliver the necessary energy to cause the perturbation of the index of refraction of the air that the laser beam is traveling through to cause it to scatter and be intercepted.	1486	1791	2868	2886

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91A

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Army Research Institute - 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 systems changes envisioned for transformation to the Objective Force. In FY03, focus on the ability of people to detect and react to changes in the digital environment. In FY04, address the development, utilization, and maintenance of values under stressful conditions. In FY05, focus on conditional reasoning and performance in the context of decision-making.	0	291	300	300
Totals	9545	15748	18775	18890

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91C

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
91C ILIR-MED R&D CMD	3485	3658	3862	3897	4010	4086	4184	4278

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 Aeromedical Research Laboratory, the Institute of Surgical Research, the Research Institute of Environmental Medicine, the Medical Research Institute of Chemical Defense, the Medical Research Institute of Infectious Diseases, and Walter Reed Army Institute of Research. Research areas will 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program element contains no duplication with any effort within the Military Departments. This project supports the Objective transition path of the Transformation Campaign Plan (TCP).

There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91C

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>In FY 2002, explored opportunities for identification of new countermeasures against militarily relevant infectious diseases using state-of-the-art techniques such as DNA microarray technology to facilitate identification of candidate genes for drug and vaccine development. Studied new vaccine delivery mechanisms including needle-less delivery. Pursued modeling to predict physiological, operational stressors on the battlefield. Studied the use of gene therapy to reverse early tissue damage in organs. FY03, perform research to further exploit candidate countermeasures against militarily relevant infectious diseases identified through application of microarray technology. Investigate candidate methods of testing for infection. Perform research to further develop models to predict physiological, operational stressors on the battlefield. Exploit use of promising gene therapies to reverse early tissue damage in organs. FY04, solicit basic research proposals and make awards that focus on militarily relevant research to identify countermeasures against infectious diseases, defense against environmental extremes and operational hazards to health, and mechanisms of combat trauma and innovative treatment and surgical procedures. Monitor progress of research and evaluate scientific results from final reports. FY05, continue research efforts begun in FY04.</p>	3485	3658	3862	3897
Totals	3485	3658	3862	3897

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91D

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
91D ILIR-CORPS OF ENGR	696	1202	1484	1469	1562	1573	1607	1644

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 within the seven Corps of Engineers laboratories. Past and current ILIR efforts have had and are having significant impacts on technology development efforts supporting the Army Transformation to the Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The work under this program element is performed by the U.S. Army Engineer Research and Development Center. This program element contains no duplication with any effort within the Military Departments. This project supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
91D

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Battlespace Environment/Military Engineering/Environmental Quality and Installations - In FY02, investigated the effects of soils on the strength of ground and air surface waves as input to the design of a short-range ground radiowave communications system for networked battlefield sensors. Assessed effectiveness of using a generalized filtering technique to classify hyperspectral data for use in terrain analysis. Developed a technique that maps the processes of cracking in construction materials while under dynamic loading conditions which is essential in preparing hardened materials for use in the battlefield. Investigated methods to kill potential pathogens, such as Anthrax spores, in soils as a prerequisite to developing approaches to decontaminate soils in diverse environmental conditions. In FY03, explore the chemical phenomena needed to ultimately develop highly selective and sensitive DNA biosensors for detection of explosives, including vapor signatures of landmines and unexploded ordnance. Investigate fluorescence signatures as a means of detecting and monitoring biological hazards in water and soil. Exploit phase profilometry, an optical technique, to accurately measure surface topography and objects, a capability that is critical to sensing for robots maneuvering in complex terrain. In FY04, investigate 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. In FY05, conduct scientific exploration in promising research areas such as fluorescence and biotechnology.</p>	696	1202	1484	1469
Totals	696	1202	1484	1469

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	135535	140493	128798	129586	133740	135895	137338	149836
305 ATR RESEARCH	1166	1170	1196	1201	1273	1296	1313	1345
31B INFRARED OPTICS RSCH	2352	2369	2267	2273	2421	2469	2505	2571
52C MAPPING & REMOTE SENS	2213	2318	2389	2406	2492	2535	2578	2639
53A BATTLEFIELD ENV & SIG	3661	3759	2586	2579	2746	2745	2729	2849
74A HUMAN ENGINEERING	2589	2629	2656	2657	2837	2889	2919	2993
74F PERS PERF & TRAINING	2627	2754	2686	2737	2832	2839	2906	2930
F20 ADV PROPULSION RSCH	2462	2482	1898	1893	2044	2082	2104	2125
F22 RSCH IN VEH MOBILITY	461	484	501	502	522	533	543	556
H42 MATERIALS & MECHANICS	1911	1947	1964	1962	2097	2136	2159	2212
H43 RESEARCH IN BALLISTICS	3965	5429	6078	6079	6314	6393	6462	16380
H44 ADV SENSORS RESEARCH	3963	3995	3879	3859	4077	4157	4180	4291
H45 AIR MOBILITY	8405	2048	2134	2146	2222	2266	2310	2364
H47 APPLIED PHYSICS RSCH	3108	3117	2544	2496	2705	2731	2765	2852
H48 BATTLESPACE INFO & COMM RSC	6635	6731	5306	5242	5539	5640	5737	5818
H52 EQUIP FOR THE SOLDIER	959	1009	1004	993	1068	1083	1091	1119
H57 SCI PROB W/ MIL APPLIC	49182	52599	56196	56815	58041	59000	59404	60219
H66 ADV STRUCTURES RSCH	1426	1440	1438	1428	1540	1567	1577	1618
H67 ENVIRONMENTAL RESEARCH	3379	3308	1415	1517	829	806	788	883
H68 PROC POLLUT ABMT TECH	352	367	386	389	401	409	420	429
HA4 PERPETUAL ASSAIL & SECURE INFO SYS, RSCH, TNG & ED	3645	2430	0	0	0	0	0	0
S04 MIL POLLUTANT/HLTH HAZ	594	618	652	659	676	688	704	721
S13 SCI BS/MED RSH INF DIS	8810	9177	9579	9613	10080	10260	10414	10669
S14 SCI BS/CBT CAS CARE RS	3860	4001	4204	4222	4401	4482	4563	4672
S15 SCI BS/ARMY OP MED RSH	5290	5500	5721	5740	6031	6137	6227	6381
S17 MOLECULAR BIOLOGY-HIV	413	0	0	0	0	0	0	0
S19 T-MED/SOLDIER STATUS	587	583	667	688	708	722	740	756

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

T22	SOIL & ROCK MECH	1775	1882	1950	1960	2031	2067	2098	2150
T23	BASIC RES MIL CONST	1502	1578	1649	1659	1711	1746	1781	1821
T24	SNOW/ICE & FROZEN SOIL	2078	1185	1201	1184	1274	1295	1294	1328
T25	ENVIRONMENTAL RES-COE	4234	4435	4652	4687	4828	4922	5027	5145
T30	ANIMAL MODELING GENETICS RESEARCH	0	953	0	0	0	0	0	0
T55	DISPLAY PERFORMANCE & ENVIRONMENTAL EVALUATION	1931	0	0	0	0	0	0	0
T56	BIOFILM RESEARCH	0	953	0	0	0	0	0	0
T57	DESERT TERRAIN ANALYSIS	0	2669	0	0	0	0	0	0
T58	KNOWLEDGE MANAGEMENT FUSION CENTER	0	2859	0	0	0	0	0	0
T59	PREDICTION OF LAND-ATMOSPHERE INTERACTIONS	0	1715	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element sustains U.S. Army scientific and technological superiority in land war fighting capability, provides new concepts and technologies for the Army's Objective 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 in 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 five primary contributors: 1) the Army Research Laboratory (ARL), which includes the Army Research Office; 2) the Army Materiel Command Research, Development and Engineering Centers (RDECs); 3) the Army Corps of Engineers Research and Development Center (ERDC); 4) the Army Medical Research and Materiel Command laboratories; and 5) the Army Research Institute. The basic research program is coordinated with the other Services via the Joint Directors of Laboratories panels, Project Reliance, and other interservice working groups. This program responds to the scientific and technological requirements of the Department of Defense Basic Research Plan, the Army Science and Technology Master Plan, and the Army Modernization 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 and is appropriately in Budget Activity 1. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	144240	139633	140230	143306
Current Budget (FY 2004/2005 PB)	135535	140493	128798	129586
Total Adjustments	-8705	860	-11432	-13720
Congressional program reductions		-1000		
Congressional rescissions		-8403		
Congressional increases		13550		
Reprogrammings	-6120	-807		
SBIR/STTR Transfer	-2585	-2480		
Adjustments to Budget Years			-11432	-13720

Change Summary Explanation:

FY03 Congressional Adds:

PASIS: Perpetually Assailable and Secure Information Systems, Research, Training and Technology, Project HA4 (\$2550); Animal modeling genetics research, Project T30 (\$1000); Biofilm Research, Project T56; (\$1000); Knowledge Management Fusion Center, Project T58 (\$3000); Optical Technologies Research; Project H57 (\$1400); Prediction of Land-Atmosphere Interactions, Project T59 (\$1800); Integrated Desert Terrain Analysis, Project T57 (\$2800)

Projects with no R-2As:

- Research in Vehicle Mobility, Project F22: Conduct research in support of advanced military vehicle technology with emphasis on advanced propulsion, sophisticated vehicle dynamics and simulation, and advanced track and suspension concepts.
- Processes in Pollution Abatement Technology, Project H68: Provide fundamental understanding of the physical, chemical and biological properties of hazardous wastes and mechanisms that control their degradation and treatment on military installations.
- Military Pollutants and Health Hazards, Project S04: Develop innovative, less costly, and less time consuming toxicity assessment methods for determining potential human health and environmental effects of military-unique hazardous wastes and chemicals, including explosives, propellants, and smokes.
- Molecular Biology/Military HIV Research, Project S17: Develop methods for the prevention, early diagnosis, and treatment of human immunodeficiency virus (HIV)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

- Telemedicine Soldier Status Research, Project S19: Provide realistic, simulated representations of medical procedures based upon R&D of enabling technologies in tissue modeling, haptics integration, graphics, and physiological representations and overall systems architecture.
- PASIS: Perpetually Assailable and Secure Information Systems, Research, Training and Technology, Project HA4 (\$2550): This one year congressional add provides funding to the Center for Perpetually Available and Secure Information Systems for a future-looking, highly multidisciplinary research program investigating all aspects of availability and security of information systems. No additional funding is required to complete this project.
- Animal modeling genetics research, Project T30 (\$1000): The purpose of this one year Congressional add is to support modeling the genomics and proteomics (protein based) in research animals to allow for gene-based therapy and diagnosis in humans. No additional funding is required to complete this project.
- Biofilm Research, Project T56; (\$1000): This one year congressional add supports research in microbiology and bioremediation to clean up contaminated toxic wastes at Army sites in a cost effective and environmentally benign manner. No additional funding is required to complete this project.
- Knowledge Management Fusion Center, Project T58 (\$3000): The purpose of this one year Congressional add is to fund basic research to provide an understanding of fundamental data fusion issues that must be addressed to enhance battlespace situation awareness and leverage net centric warfare. No additional funding is required to complete this project.
- Prediction of Land-Atmosphere Interactions, Project T59 (\$1800): 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.
- Integrated Desert Terrain Analysis, Project T57 (\$2800): This one year congressional add supports research on the impacts of Army combat vehicle training on desert ecosystems, in particular vegetative cover, soil, water quality and wildlife with a goal of improving the sustainability of Army desert training lands. No additional funding is required to complete this project.

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February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
305

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
305 ATR RESEARCH	1166	1170	1196	1201	1273	1296	1313	1345

A. Mission Description and Budget Item Justification: 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 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, detecting and identifying targets over extended battlefield conditions, are essential for the warfighter in Future Combat Systems (FCS). The research resulting from this project 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 that ultimately will utilize that knowledge to conceptualize and design advanced Automatic Target Recognition (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. 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
305

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- In FY02, designed new ATR approach using hyperspectral data cubes and compared hyperspectral ATR algorithms to broadband and dual band ATR performance; provided framework for use of synthetic target image chips in the development of classifier algorithms. In FY03, quantify results of preliminary algorithm development and report results; research the improvement resulting from the formulation; conduct fundamental studies into new detection and clutter rejection techniques and use of composite classifiers over single classifiers in the ATR context. In FY04, determine the minimum number of hyperspectral bands needed for effective target recognition algorithms, and make recommendations for Army applications; investigate and specify the improvement in composite classifiers through the use of enhancing algorithms; investigate relative merits of detection and clutter rejection techniques and document results. In FY05, investigate new methods for feature extraction, including independent component analysis for land warfare applications, to reduce the impact of clutter and lessen the false alarm rate and improve classifiers; make recommendations on use of specific algorithms for land warfare applications, to reduce the impact of clutter and lessen the false alarm rate.</p>	1166	1170	1196	1201
Totals	1166	1170	1196	1201

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
31B

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
31B INFRARED OPTICS RSCH	2352	2369	2267	2273	2421	2469	2505	2571

A. Mission Description and Budget Item Justification: This project supports the Army's theoretical and experimental research in materials and devices for active and passive infrared (IR) imaging systems. It generates new technologies to obtain unprecedented awareness of the battlefield and to continue to "own the night". To achieve these objectives for the Objective Force, IR Focal Plane Arrays (IRFPAs) with significantly improved performance, lower cost, and increased operating temperatures and compact low cost laser radar (LADAR) architectures are needed. Research is focused on material growth, detector design and processing for large area multicolor IRFPAs. The main efforts are directed towards mercury cadmium telluride (HgCdTe) detector arrays grown on silicon (Si) substrates, antimonide (Sb) base super lattices, and quantum well and dot infrared photon detectors. For the compact frequency modulated/continuous wave (FM/CW) LADAR, research has to be performed for some critical components, especially for a high frequency detector/modulator array. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, Project reliance. This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
31B

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- In FY02, various detector structures were grown, fabricated and tested using HgCdTe and semi-conducting materials; impurity levels in HgCdTe materials were reduced and high operating temperatures (HOT) structures were grown and IR detectors fabricated and tested for improved LADAR performance; fabricated and characterized a 32 x 32 detector array for the Army LADAR program. In FY03, complete fabricate and test mid-wave infrared (MWIR) large-format (1024 x 1024 pixal detector arrays on silicon; evaluate MWIR high operating temperature detectors. In FY04, characterize large format MWIR IR FPAs staring passive ladar detector arrays and grow and characterize LWIR detector structures on Si. In FY05, grow and characterize large area LWIR detector structures, HOT detector arrays, and evaluate integrated passive and active LADAR detector arrays.	2352	2369	2267	2273
Totals	2352	2369	2267	2273

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
52C

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
52C MAPPING & REMOTE SENS	2213	2318	2389	2406	2492	2535	2578	2639

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 multisensor 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 to provide real-time terrain intelligence, command and control, and targeting support. This research investigates new methods of exploiting terrain and environmental data to improve situational awareness and enhance information dominance leading to increased survivability, lethality, and mobility capabilities for the Future Combat Systems and Army Vision/Joint Vision 2020 concepts. The research provides the theoretical underpinnings for program element 0602784A, project 855. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
52C

Accomplishments/Planned Program

Seismic/Acoustic Sensor Placement – In FY02, completed analysis of existing data on overburden estimation. In FY03, investigate modeling approaches which support optimal sensor placement. In FY04, establish methodology for estimating overburden depths and identifying optimal sensor placement locations. Terrain Categorization (TERCAT) – In FY02, collected and analyzed raw emittance and reflectance data signatures against defined target sets. In FY03, investigate appropriate spectral bands for TERCAT applications, and analyze classification algorithms. In FY04, test prototype automated classification algorithms utilizing bi-directional reflectance data from corrected overhead imagery. Test prototype hyperspectral signal exploitation algorithms. In FY05, establish a regime for low-bandwidth hyperspectral data collection and compression of data that is collected. Develop and test prototype hyperspectral thermal exploitation algorithms. Automatic Feature Extraction – In FY03, identify and analyze regional characteristics of several distinct zonal areas. In FY04, investigate prototype algorithms to automate analysis of region specific features. In FY05, define region-specific key terrain for exploitation by automated processes, prototype an automated region-specific feature analysis capability, and test automated feature extraction algorithms against ground-truthed spectral datasets. Laser-induced Fluorescence – In FY02, collected baseline signature data. In FY03, investigate algorithm development for exploiting fluorescence data. In FY04, refine algorithms for identifying biological hazards. In FY05, test prototype algorithms for identifying biological hazards in water. Investigate the use of active remote sensing techniques for standoff detection of chemical and biological hazards.

FY 2002	FY 2003	FY 2004	FY 2005
2213	2318	2389	2406
Totals	2213	2318	2389

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
53A

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
53A BATTLEFIELD ENV & SIG	3661	3759	2586	2579	2746	2745	2729	2849

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 characteristics and detection of chemical and biological aerosols, and the propagation of full-spectrum electro-magnetic and acoustic energy. The Army of the future will be required to operate in very complex environments 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 battle field commanders. This project focuses on boundary layer meteorology over land and urban terrain. It supports the Army's transformation to the Objective Force through the development of future capabilities and applications in such areas as the detection and identification of biowarfare agents, enhanced acoustic and electro-optic propagation modeling techniques for improved target detection and acquisition, and the development of objective analysis tools that can assimilate on-scene weather observations and fuse this information with forecasts to provide immediate now cast 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, the DoD Basic Research Plan and Project Reliance. This program element contains no duplication with any effort within the Military Departments. Work in this project is performed by the Army Research Laboratory (ARL). This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
53A

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- Research in optical and acoustical propagation in the atmosphere for enhanced Intelligence, Surveillance and Reconnaissance (ISR) capabilities for the Objective Force and FCS for situational understanding and rapid targeting. FY02, improved tactical target acquisition by employing new imaging techniques like polarization characterization and determined the atmospheric effects in forest canopies on acoustic propagation for improving acoustic sensors. FY03, conduct lab and field measurements in the infrared (IR) domain leading to the discrimination of polarimetric signatures. Also, analyze acoustic characteristics for intermittent turbulence conditions of a stable nocturnal boundary layer and develop a neural network for making acoustic propagation predictions. FY04, improve target recognition/identification using imaging techniques that more completely characterize the state of reflected thermal radiation. Investigate techniques to make battlefield acoustics sensors systems self-aware of their environment for improved performance capabilities in degraded atmospheric conditions. FY05, investigate technologies for quantifying turbulence effects on imaging sensors in a real battlefield situation. Perform research in high-fidelity acoustic signature simulation systems for developing synthetic acoustic signatures.	1875	2100	1772	1571
- Survivability of Objective Force and improved 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. FY02, advanced the capability of high-resolution forecast models for the Objective Force operating in target areas. Additionally, conducted initial field measurements of natural background aerosol particles to distinguish between hazardous and non-hazardous particulates. FY03, perform field experiments and data analysis for an urban area furthering the knowledge of forecast model accuracy and improving standoff detection and classification of hazardous aerosols. FY04, evaluate microscale forecast and transport/diffusion models using real data for urban and complex terrain. FY05, investigate new methods to determine the accuracy of small scale/limited domain models. Also, develop techniques to predict the detail scattering signature response of aerosols for improved remote sensing and standoff detection and classification of hazardous airborne aerosols.	1786	1659	814	1008
Totals	3661	3759	2586	2579

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601102A - DEFENSE RESEARCH SCIENCES					PROJECT 74A			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
74A HUMAN ENGINEERING	2589	2629	2656	2657	2837	2889	2919	2993	

A. Mission Description and Budget Item Justification: This project focuses on research on soldier-system performance in Interim- and Transformation-relevant 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; humans 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 the ramp-up to Transformation. Accordingly, technical solutions are being pursued in the areas of data generation and algorithm development, given that soldiers have never operated 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. All of the work in this program is included in the Army Strategic Research Objective (SRO) titled "Enhancing Soldier Performance". The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project reliance. This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). Program supports the Objective Force transition path of the Transformation Campaign Plan (TCP). No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
74A

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Research to improve soldier auditory performance: In FY02: Conducted research to determine the best approach for improving spatial perception of combat important sounds in adverse listening conditions. Matured the Callsign Acquisition Test for assessing speech intelligibility of Military Communications Systems. Evaluated methods to quantify the combat arms earplug on speech recognition and signal source detection. In FY03: Identify critical aspects of recognition of acoustic signatures and warning signal. Determine human capabilities in auditory distance estimation and quantify soldier auditory performance in the presence of impulse noise. Determine sound quality metrics and controlling algorithms for evaluation and standardization of immersive acoustic environments to improve soldier simulation experiments. Identify and quantify the effects of whole-head helmet on speech communication and auditory detection and optimize head mapping for bone conduction microphone placement. FY 04: Determine auditory requirements and trade-offs for an acoustically transparent whole-head helmet for the Objective Force Warrior. FY05:Mature remotely controlled binaural microphone system for the Future Combat System (FCS).</p>	1082	1115	1148	1136
<p>- Research to improve soldier cognitive performance: In FY02: Studied electrophysiological measures of cognitive performance; generated multivariate and hierarchical models of soldier performance under a variety of stressful conditions and transitioned results to continue refinement of Improved Performance Research Tool (IMPRINT) for human dimension analyses. In FY03: Investigate cognitive readiness assessment tools to measure war fighting effectiveness. Document soldier performance effects of individual differences and situational characteristics in multi-tasking scenarios. Link data from brain and behavior research to feed and validate cognitive models of soldier performance. Devise models of perceptual, cognitive, and multi-tasking workload representing Objective Force soldier performance with proposed enhanced sensory input technology. In FY04: Provide tools, models, and results to Objective Force design and development teams; field-validate predictive models and integrate models and results with large-scale representations of system and unit performance. In FY05: advance error prediction and decision making models to complex Objective Force environments for technology design evaluation and design cognitive modeling interface for rapid propagation of cognitive models in Army models and simulations.</p>	1507	1514	1508	1521
Totals	2589	2629	2656	2657

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
74F

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
74F PERS PERF & TRAINING	2627	2754	2686	2737	2832	2839	2906	2930

A. Mission Description and Budget Item Justification: This project covers behavioral science research in areas with high payoff opportunities for improved personnel selection, training, leadership, and performance, including: assessments of practical intelligence as an aptitude that can be measured across job domains; identify 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 accelerating leader development; 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 transforming the human component of war fighting in synchronization with the transformations in systems, technologies, weapons, and operational requirements to meet the goals of the Objective Force. This project is managed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This project contains no duplication with any effort within the Military Departments. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP). It does not contain Defense Emergency Response Funds (DERF).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
74F

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- FY 02, identified behavioral factors that enhance or diminish speed, durability, and transferability of training of verbal and spatial tasks; developed and validated tacit knowledge inventory to assess leadership problem-solving experience levels; identified differential factors and life-course trends affecting the propensity of high school males and females to enlist in the Army. FY03, develop multi-source measure of socially intelligent job performance; develop computerized diagnosis of leadership training needs and assessment of leadership training effectiveness; identify potential training requirements for leaders of electronic-based teams. FY04, explore practical job knowledge assessment instruments; assess trainability of sense-making (situation awareness) skills; assess trainability of skills for rapid interpretation of large volumes of ambiguous electronic data. FY05, validate test battery for measuring mental flexibility; assess memory for spatial and temporal events in electronic environments.	2627	2754	2686	2737
Totals	2627	2754	2686	2737

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
F20

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
F20 ADV PROPULSION RSCH	2462	2482	1898	1893	2044	2082	2104	2125

A. Mission Description and Budget Item Justification: The goal of this effort is increased performance of small air-breathing engines and power trains that will support Army Transformation in the areas of system mobility, reliability and survivability, and ultimately serve to reduce the logistics cost burden for the Objective Force. Problems include the ability to achieve greater fuel efficiency and reduce weight in these propulsion systems. Technical barriers to advanced propulsion systems are the maximum temperature that today's materials can safely withstand, 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY
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PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
F20

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- FY02: Evaluated a MEMS injector hardware design to enhance turbine engine stability and performance; improved structural ceramic life prediction model for engine reliability; and transitioned a new engine weight and safety prediction algorithm into the National Propulsion System Simulation code. Established gear design standards for crack propagation that were adopted by the rotorcraft industry; incorporated elasto-hydrodynamic effects into advanced journal bearing codes; conducted a preliminary analysis of atmospheric effects on foil bearing performance leading to improved safety, reliability, performance, and durability of future rotorcraft transmission drive systems. FY03: Add environmental effects into propulsion material life prediction and performance models; develop, for the first time, analytical capability to predict onset of compressor stall in full axi-centrifugal compressor system; develop advanced lubrication independent thrust bearing concepts in support of oil-free engines for advanced platforms. FY04: Develop advanced lubrication independent thrust bearing concepts in support of oil-free engines and conduct research into alternative energy conversion processes and energy sources, e.g., fuel cells. FY05: Investigate materials processing and life prediction methods for ceramics. Assess novel concepts for UAVs. Analyze low vibration high load capacity power transmission component, material concepts, and analytical tools.</p>	2462	2482	1898	1893
Totals	2462	2482	1898	1893

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601102A - DEFENSE RESEARCH SCIENCES					PROJECT H42			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H42 MATERIALS & MECHANICS	1911	1947	1964	1962	2097	2136	2159	2212	

A. Mission Description and Budget Item Justification: This project funds the Army's basic research program 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. Technical barrier is that with current materials, to gain added functionality for Army systems, one must use a layered approach whereby each layer provides added capability (ie. ballistic, chem./bio, signature, etc) but ultimately the system is 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 Objective Force. This research supports materials technology applied research in project 0602105A/AH84. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, Project reliance and supports the Objective Force transition path of the Transformation Campaign Plan (TCP). This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY
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0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H42

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>FY02, determined complex micro structural relationships between interphase and bulk composite properties of lightweight integral armor materials; correlated morphology and interfacial properties with mechanical performance in multilayered laminates and layered silicate nanocomposites; characterized dynamic and static material properties of advanced ceramics that can be tailored to control the onset of ballistic failure for improved lightweight armors; devised analytic models and experimental techniques for describing material response of dynamically loaded anti-armor concepts; and evaluated large strain viscous models against measured data and completed new internal viscous constitutive model for elastomers. In FY03, extend and validate physics-based models and experimental techniques to enable exploitation of composite material interphase design methodologies for transition to developers of high-performance, lightweight integral armors; refine structure/property relationships and processing techniques for tailoring performance of advanced polymer systems to be used in integrated materiel systems; devise first-principles ceramic design tool; incorporate analytic model of dynamic penetrator fracture into design codes; and improve analyses for inflatable fabric structures. In FY04, conduct basic research to enable design of advanced composite material-based structures with inherent electro-opto-chemical properties enabling revolutionary multifunctional performance of lightweight armors; conduct basic research to create hierarchically organized materials systems that possess multifunctional attributes that will enable revolutionary survivability in Objective Force Warrior systems; validate ceramic design tool with theory critical experiments; and experimentally characterize dynamic fracture response of candidate anti-armor materials under ballistic loads.</p>	1911	1947	1964	0
<p>- In FY05, advance electro-opto-chemical integration capabilities of next-generation composite structures for improved multifunctionality (e.g., sensory, communications, power); advance fundamental understanding of structure-property-processing relationships in hierarchical material systems to produce tailored functionality in Objective Force Warrior systems; verify micro-structure (including fractography) of armor ceramics that have been subjected to impact and conduct mechanical (fracture toughness, hardness) and non-destructive test characterization of armor targets containing silicon carbide and boron carbide armor ceramics; and incorporate second generation dynamic fracture model into computational continuum mechanics code to enable development of improved anti-armor concepts.</p>	0	0	0	1962
Totals	1911	1947	1964	1962

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H43

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H43 RESEARCH IN BALLISTICS	3965	5429	6078	6079	6314	6393	6462	16380

A. Mission Description and Budget Item Justification: This project funds the Army's basic research program in ballistics. The goal is to improve the understanding of the chemistry and physics controlling the propulsion and flight of gun launched projectiles and the flight of missiles, and to understand the interaction of these weapons with armored targets. This research results in the science base 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 Objective Force. This research is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD in support of ballistic technology applied research in project 0602618A/AH80. Effort supports 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, Project Reliance and supports the Objective Force transition path of the Transformation Campaign Plan (TCP). This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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1 - Basic research

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0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H43

Accomplishments/Planned Program

- In support of the National Advanced Energetics Initiative, expand and validate physics based models and experimental techniques to devise chemical formulations that will enable design of novel insensitive high-energy propellants and explosives with tailored energy release for revolutionary Objective Force lethality and survivability. In FY02, employed fundamental and 3-D interior ballistics models and experimental techniques to understand the interaction of electrically generated plasmas with propellants and explicitly model shock and detonation propagation in propellant beds. In FY03, expand first principles design tools to enable tailoring of chemical formulations. In FY04, characterize/model the chemical and physical properties of novel energetic materials to establish the relationship between particle-size, energy density and release rate for insensitive high-energy propellants and explosives. Explore 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 tailored energy release of insensitive high-energy propellants and explosives, including multiple-mode applications for energetic materials.

FY 2002	FY 2003	FY 2004	FY 2005
1726	3103	3770	3759

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0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H43

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- In FY02, expanded ceramic micro mechanical model to describe inter-granular flow, grain size, orientation, and boundary chemistry and conducted fundamental experiments to determine damage evolution under ballistic load; devised analytic model and conducted fundamental experiments to determine adiabatic shear onset criterion in emerging anti-armor alloys; and coupled high performance computational design tools (aerodynamics/structures) to calculate control aerodynamics of non-axisymmetric munition body shapes. In FY03, validate ceramic micro mechanical model using theory critical experiments and integrate model into numerical code; refine adiabatic shear model based on micro mechanical experiments of candidate alloy materials; and incorporate structural flight vehicle response, aerodynamics, propulsion, guidance, navigation and control to enable a comprehensive design and evaluation capability. In FY04, correlate ballistic performance of armor ceramics with fundamental material properties and material behavior using non-ballistic evaluation methods; investigate shear band velocity as influenced by driving imperfections found in anti-armor devices and validate refined shear model in computational continuum mechanics code to support improved analysis of armor/anti-armor interactions; and devise algorithms to model fully-coupled roll controlled pitch up maneuver employing coupled CFD/ Structures/GN&C and non-axisymmetric high alpha aerodynamics CFD to enable design of complex precision munitions for the Objective Force. In FY05, prove ability to model penetration through advanced ceramic armor and accurately capture the observed material response for each phase of penetration; incorporate adiabatic shear model into computational continuum mechanics code and validate; and prove capability to model fully coupled roll controlled pitch up maneuver and validate full high performance computational capability of coupled models employing multiple processors.</p>	2239	2326	2308	2320
Totals	3965	5429	6078	6079

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BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H44

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H44 ADV SENSORS RESEARCH	3963	3995	3879	3859	4077	4157	4180	4291

A. Mission Description and Budget Item Justification: This project exploits the basic sciences to enable new sensing capabilities for the Army's Objective Force. This work will 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 digital and image processing modules and algorithms, beam propagation material modeling in nonlinear optical materials and devices, remote sensing and intelligent system distributive interactive simulations and battlefield acoustic signal processing algorithms. Research involves fundamental science and engineering principles that support 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. For laser protection, nonlinear optical effects are being explored which will allow broadband protection. These nonlinear effects can also be used for optical image processing or holographic displays and storage. 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, improve cryptography techniques, improved language translation, and improved sensor protection. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, Project reliance and supports the Objective Force transition path of the Transformation Campaign Plan (TCP). This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H44

Accomplishments/Planned Program

- Research is focused on: investigating and evaluating image-processing techniques for large arrays of opto-electronic feedback circuits and providing computational multilingual tools for machine translation critical to combating terrorism: i.e.: Arabic, Pacific Rim, and Persian-Farsi. In FY02: incorporated advanced theoretical techniques by integrating a micro-mirror array from an ARL/ARO Multi University Research Initiative (MURI) at Boston University with a Very Large Scale Integration (VLSI) chip control into a bench scale adaptive optical system. This capability is a world record for adaptive optics atmospheric turbulence correction systems and is required for high-speed laser targeting and communications systems. In FY03: conduct experiments in the laboratory, the ARL outdoor laser communication, and laser imaging circuit with advanced analytical techniques; conduct characterizations, ontologies, and linguistic structures of Arabic and Persian and test translation modules. In FY04: conduct experiments for imaging for missile and weapons systems applications and transition to RDECs; extend characterizations, ontologies, and linguistic structures to Pacific Rim languages. In FY05: complete experiments for imaging for missile and weapons systems applications and transition to RDECs; (2) transfer language translation prototypes and multilingual search tools to intelligence user community for evaluating and testing.

FY 2002	FY 2003	FY 2004	FY 2005
1578	1600	1474	1419

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BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H44

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- In FY02: characterized EM model for tactically sized targets at UHF frequencies necessary for locating targets under trees; characterized Surface Enhanced Raman Scattering (SERS) signal from bio agents from bacterial endospores and gram positive and negative bacteria in vegetative state; investigated new advanced processing techniques that exploit multiple networked sensor modalities and information encoded in quantum states; provided more realistic beam propagation codes for eye protection from lasers to address soldier survivability. In FY03: continue to characterize EM model for tactically sized targets at UHF frequencies; measure SERS spectra and compare several different bacterial types and identify relevant markers; investigate time frequency signal processing for detection and classification of transients for applications of networked sensors, and conduct a fundamental investigation into quantum information processing; incorporate low f number propagation to the existing codes. In FY04, establish capabilities to model multiple targets embedded in distributed clutter through L-band frequencies; continue to measure SERS spectra and compare several different bacterial types and identify relevant markers; improve efficiency and optimization of processing techniques for networks of sensors and processing for quantum states. In FY05: quantify improvement in performance available through the application of video enhancement algorithms for passive millimeter wave camera images; mature a neural network capable of identifying selected bacteria; explore efficient signal processing algorithms for data fusion and networks of sensors of various modalities; and make recommendations for applications of quantum information processing; use codes to optimize optical designs for nonlinear material placement in the optical train.</p>	2385	2395	2405	2440
Totals	3963	3995	3879	3859

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601102A - DEFENSE RESEARCH SCIENCES					PROJECT H45			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H45 AIR MOBILITY	8405	2048	2134	2146	2222	2266	2310	2364	

A. Mission Description and Budget Item Justification: This project provides funding for aviation basic research in aerodynamics for manned and unmanned rotarywing 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 tiltrotor aircraft. The efforts in this project will result in a better understanding of rotorcraft airfoil and rotor performance and will result in improved safety, and ultimately, improved combat effectiveness of the manned and unmanned rotorcraft in the Objective Force. This project supports the Objective Force and Joint Vision 2020 by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotarywing aircraft. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, Project Reliance, and supports the Objective Force Transition path of the Transformation Campaign Plan (TCP). This program element contains no duplication with any effort within the Military Departments. The U.S. Army Aviation and Missile Command, Redstone Arsenal, Alabama performs the work in this project. No Defense Emergency Response Funds were provided to the program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H45

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- In FY02, performed test to take necessary data for far wake measurement for helicopter and tiltrotor; investigated experimental data to quantify Tiltrotor Vortex ring state measurement; conducted fundamental research for autonomous control of rotorcraft unmanned aerial vehicles; conducted test of 2D variable droop leading edge airfoil; investigated active flow control impact on rotorcraft, and evaluated active twist rotor concepts using neural net closed loop controllers; using simulation, generated a synthetic vision database for sensor fusion requirements. In FY03, design and fabricate a high lift 2D airfoil for low Reynolds number flow, CFD code development for ducted-fan and co-axial rotor, conduct 2D airfoil test with Gunny flap to increase lift and reduce drag. In FY04, conduct wind tunnel test to reduce drag force of mast mount sensor (MMS)shape, conduct performance test for co-axial and ducted-fan UAV. In FY05, conduct rotor test to study the off-axis stability to increase helicopter handling quality.	8405	2048	2134	2146
Totals	8405	2048	2134	2146

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H47

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H47 APPLIED PHYSICS RSCH	3108	3117	2544	2496	2705	2731	2765	2852

A. Mission Description and Budget Item Justification: The objective of this project is to investigate electronic semiconductor 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; and advanced batteries and more efficient fuel cells for hybrid power. Specifically, this project addresses research to determine carrier transport properties and lifetimes of a variety of important optoelectronic materials and structures, such as those used in light emitting devices, high power lasers, detector/modulators for laser radar (LADAR), IR detector structures, and eye safe laser sources. In addition, this project addresses enhancing the molecular mechanisms that give rise to nonlinear optical effects such as sensor and eye protection. Investigate electronic materials and structures to improve wide band gap semiconductor performance in electric vehicles and advanced radar systems. Technical barriers affecting performance, weight, cost, and power consumption will be addressed. These investigations will support the development of optoelectronic devices, power sources and specialty electronic materials for the Army's Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).
No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H47

Accomplishments/Planned Program

- This research is focused on: Diode pumped Erbium Ytterbium (Er/Yb) glass laser for designators, range finders and radars; electrolyte 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; Organic Light Emitting Diodes (OLED) for future Army displays; nonlinear optical (NLO) materials for sensor & eye protection; and Inter-sub-band device theory, simulation, and experiment for imagers. FY02: Completed 3D laser cavity model with passive Q-switch; synthesized nanophase electrode materials for advanced batteries and direct methanol fuel cells; designed new higher-power higher-reliability gate-turn-off (GTO) thyristor from simulation; established new OLED model that permitted the characterization of transport properties; measured limit-curves of several NLO materials for comparison to eye damage thresholds; and matured model and designed intersub-band transition based laser. FY03: design new catalyst for hydrocarbon fuel reformers; fabricate low-defect gallium nitride (GaN) films; establish OLED fabrication techniques and material synthesis; investigated bichromophores & dendrimers with NLO chromophores; and create simulation of electrical & spectral properties of materials for novel IR imaging applications. FY04: evaluate solid electrolytes for rechargeable high-energy batteries; examine silicon carbide (SiC) structures, and ohmic contacts for transition to efficient device designs; investigate hybrid organic/inorganic OLED structures; design a dendrimer NLO material; and adapt successful EM model for IR focal plane arrays (FPA). FY05: provide fire-retardant electrolyte for batteries & catalysts for fuel cells; examine GaN structures, and ohmic contacts for transition to efficient device designs; and transition OLED technology to rugged flexible substrates.

FY 2002	FY 2003	FY 2004	FY 2005
3108	3117	2544	2496

Totals

3108	3117	2544	2496
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H48

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H48 BATTLESPACE INFO & COMM RSC	6635	6731	5306	5242	5539	5640	5737	5818

A. Mission Description and Budget Item Justification: This project addresses fundamental research in technologies that will enable intelligent and survivable command, control, communication, and intelligence systems for the Objective 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 multipath 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H48

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- 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 of networked nodes. In FY 02, showed improvements in information flow in a mobile ad hoc network with a prototype suite of networking and control protocols; investigated and designed techniques to enhance the performance of networks of unattended ground sensors. In FY03, investigate and identify a suite of signal processing techniques to provide bandwidth on demand in interference and jamming scenarios, including challenging urban and foliage scenarios. In FY04, devise 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.</p>	2691	2521	2403	2436
<p>- 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 FY02, provided laboratory infrastructure and computational multilingual tools to support tactical, intelligence, and coalition operations that provide language independent representations of meanings and translingual information search and retrieval; identified theoretical architecture for human interaction with physical and software agents; enhanced control infrastructure for cooperating physical agents in laboratory demonstrations; tested formal representation concepts with a universal primary key naming convention. In FY03, explore/devise scalability of information processing techniques and natural human interfaces with software agents to reduce soldier cognitive load in maintaining situational awareness on the battlefield, where hundreds to thousands of computer objects and human operators interact constantly. In FY04, incorporate 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. In FY05, devise analytical techniques to interface soldiers and robotic elements in a seamless manner in the battlefield information system.</p>	2250	2406	1417	1293

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H48

	FY 2002	FY 2003	FY 2004	FY 2005
<p><u>Accomplishments/Planned Program (continued)</u></p> <p>- 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 FY 02, conducted laboratory experiments and validated the robustness of intelligent based vulnerability assessment over a low bandwidth network; extended agent based vulnerability assessment techniques to incorporate secure key management. In FY03, identify intelligent agent and mobile code techniques to address emerging and evolving information attacks by potential adversaries on sensor networks on the future battlefield to protect data input to situational awareness systems. In FY04, incorporate analytical and protocol techniques into mobile communication devices and systems to enhance robustness to unattended network intrusion and sensor spoofing for deployable sensor networks with operating under severe energy constraints. In FY05, evaluate and implement selected best of breed security services embedded authentication services for unattended static and mobile sensor networks deployable on the battlefield.</p>	1694	1804	1486	1513
Totals	6635	6731	5306	5242

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H52

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H52 EQUIP FOR THE SOLDIER	959	1009	1004	993	1068	1083	1091	1119

A. Mission Description and Budget Item Justification: This project supports basic research required to achieve the Objective Soldier and the Army Transformation. The research is focused on five core technology areas critical to soldier systems: mathematical modeling, physical performance measurement, polymer science/textile technology, nanotechnology and food technology. 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 Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the US Army Natick Soldier Center, Natick, MA. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).
No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H52

Accomplishments/Planned Program

In FY02: Validated the utility of a model to assist in the design of better methods to carry loads. Developed biomechanical and motor control methodologies to provide guidelines for improved load carriage and reduced soldier fatigue. Measured effects of electric fields on alignment of carbon nanotubes. These materials exhibit properties which suggest they can be used in transparent polymers for eye protection and ballistic shields for body armor. Transitioned models on high rate phenomena occurring during ballistic impact events to 6.2 nanocomposites program. Developed cognitive testing paradigm for detection of food based performance enhancement under stressful conditions. Determined dispersion in the binding of water molecules to various components of amorphous food systems as they relate to ration stability and safety. Created a new mechanics based theory for fiber-to-fiber interfacial behavior that can provide guidelines for the development of improved fibrous materials for a soldier's advanced combat uniform. Synthesized peptide conducting polymer complexes for sensor applications in clothing and food.

FY 2002	FY 2003	FY 2004	FY 2005
959	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H52

Accomplishments/Planned Program (continued)

FY03: Develop new experiments to quantify and assess the mechanical behavior of hybrid (blended) yarns in conjunction with the new fiber-to-fiber theory to create prototypes of improved materials for the soldier system. Validate model and use imaging methods to determine formulations that improve food quality and ensure safety. Formulate and implement a novel computer based biomechanics model to assess gait and muscle control to further improve soldier load carriage performance. Evaluate effect of nanoparticle geometry on nanocomposite mechanical and barrier properties for application to ballistic and chemical biological protection. Conduct laboratory research on cognitive performance and food based performance enhancement under severe stress. Conduct research to examine the relationship among comfort, fit, and perceived fit on form fitting military clothing. FY04: Transition nanocomposite technology to chemical protection program and ballistic protection program. Evaluate potential of prototype advanced hybrid yarns to provide improved performance under ballistic impact of textile body armor. Examine cognitive performance as it relates to nutrient and fluid intake under stressful conditions related to military operational environments. Create a neural oscillator model which will be incorporated into a planer model of human walking as the primary control mechanism for application to analysis of load carriage. Examine effect of perceived fit and comfort on the use and performance of protective clothing and individual equipment. FY05: Extend first generation neural oscillator model to three dimensional human locomotion and load carriage. Integrate cognitive testing paradigm into new and ongoing warrior performance efforts.

FY 2002	FY 2003	FY 2004	FY 2005
0	1009	1004	993
959	1009	1004	993

Totals

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H57

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H57 SCI PROB W/ MIL APPLIC	49182	52599	56196	56815	58041	59000	59404	60219

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 Objective 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 Transformation 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, countermeasure, compact power, such as microturbines, and other mission-driven areas will lead to an Objective Force that is more strategically deployable, more agile, more lethal and more survivable. The breadth of this basic research program covers approximately 800 research grants and contracts with leading academic researchers and approximately 1,600 graduate students yearly, and supports research at 227 institutions in 49 states. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective transition path of the Transformation Campaign Plan

No Defense Emergency Response Funds have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H57

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Basic research in biological sciences for revolutionary advances in Command, Control, Communications, Computing, Intelligence, Surveillance, and Reconnaissance (C4ISR) and soldier survivability. In FY02, used unique biomolecular combinatorial approaches to find peptides to nuclear electronic materials allowing enhancements in electronic transport and optical efficiency for signature reduction; and adapted enzymes which will detect nerve agents in water to combat terrorism. In FY03, create biologically-derived materials with self-assembly and multifunctional capabilities for protective materials (including armor) and for nanometer-scale biocellular electronics. In FY04, direct macromolecular evolution of biological electron transfer components for microsystems with application to power and energy management and logistics footprint minimization, biologically design and construct nanometer scale electronic and photonic structures for application to precision strike weapons. In FY05, understand mechanisms of pathogenicity to combat terrorism and to aid in chemical-biological detection (CBD) through intervention of organisms that cause disease; and use molecular genetics to identify the molecular signals that affect soldier performance and endurance.</p>	6885	7415	8100	8200
<p>- Basic research in chemical sciences for advanced power generation and CBD. In FY02, synthesized novel dendrimers and polymer-based nanocomposites for chem/bio sensors and protective coatings which will rapidly detoxify agents; devised advanced energetic materials for propellants and explosives for small-diameter munitions with increased lethality and range; and advanced the ability to fabricate materials able to withstand an extraordinary number of revolutions per second leading to dime-sized micro turbines for combat power. In FY03, devise multifunctional coatings that will be able to detect and decontaminate threat agents, use computational chemistry to enable the design of light-weight, high energy density fuel cells. In FY04, devise new approaches to build molecular machines for CBD, signature management and laser protection; 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 develop novel architectures for materials with superior protection from all environments.</p>	7775	8515	9000	9000

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H57

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- Basic research in physics for precision guidance, superior signature management properties and secure communications. In FY02, created atom gyroscopes for passive, jam-proof navigation with an accuracy that exceeds Global Positioning System capabilities for precision strike; discovered the breakthrough that will lead to ultra sensitive gravity gradiometers to detect underground bunkers and tunnels; and conducted research in quantum information science to provide survivable communications, anti-access capabilities and covert electronic attack for uninterrupted access to information. In FY03, use non-linear optics to improve remote sensing and survivable communications and condensed matter physics to provide CBD and end-to-end interoperable communications. In FY04, develop high frequency superparamagnetic dot arrays to increase the area density of information storage. In FY05, develop tools in the Terahertz frequency regime for interrogation of CB agents.</p>	8675	9323	10294	10615
<p>- Basic research in communications and electronics for unmatched C4ISR capabilities. In FY02, synthesized and assembled molecules to form alternatives to silicon-based electronic circuits; devised ultraviolet detectors and digital focal plane arrays based on novel photodiodes for improved night vision devices; and combined complex proteins in an active electronic device making possible revolutionary photo detectors. In FY03, enable adaptive and secure communications addressing extremely high data rates, transmission over complex terrain, and networked communication system issues; devise multifunctional, ultra broadband sensing devices and circuit architectures, including molecular and biomolecular, for higher speed, more functional, and higher memory devices for all Army electronic systems. In FY04, use rare earth doped materials for photonic applications and apply quantum dot intersub-band photo detectors for night vision devices and to create a new class of quantum-dot lasers for Army laser designators. In FY05, research advanced countermeasure techniques to enable faster and more accurate detection of mines; integrate seismo-acoustic and chemical sensors with electro-optics and x-ray imaging for advanced landmine detection.</p>	8282	8719	9805	9900

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H57

Accomplishments/Planned Program (continued)

- Basic research in mechanical and material sciences for survivable armor, improved mobility, C4ISR components, and flexible display initiative for soldier systems. In FY02, devised a high-fidelity model for fuel combustion and heat release for advanced, low emission/high efficiency gas turbine engines; a dendrimer-based polymer composite to provide a solid state solution to sensor and eye protection from laser threats; and a novel magneto-Rheological shock absorber to control vibration of helicopter rotor blades. In FY03, improve computational modeling of materials for enhanced survivability and sustainability; control assembly of ceramics and polymers to improve fabrication and manufacturing techniques to lower costs of production; understand the structure and dynamics of shear bands in metallic glasses and nanophase composites to create improved, highly lethal penetrators; improve computational techniques and novel analytical tools to model material failure to create lightweight, damage tolerant armor materials. In FY04, understand active flow control for projectiles and air vehicles to improve precision strike; understand high impact dynamics of composite materials; and synthesize 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; and conduct research in transparent conductive and emissive materials.

FY 2002	FY 2003	FY 2004	FY 2005
7775	8435	9200	9300

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H57

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Basic research in mathematical and computer sciences as the backbone for complex, multisystem analysis, modeling and simulation, and information systems. In FY02, devised high assurance embedded system methodologies leading to improved combat casualty care medical devices; devised computational design methods based on new Chimera-related flow analysis techniques leading to enhanced helicopter and missile performance; and devised small footprint parallel Hoffman encoding and decoding at previously unattainable rates for ultra-fast secure communications. In FY03, devise new intelligent control algorithms for autonomous systems and for networked, real-time command and control; statistical decision and network theory for automatic data fusion for extremely low power, high bandwidth micro sensor networks. In FY04, translate statistical shape analysis to computer programs for improved target classification; self-organizing, self-healing mobile ad-hoc networking algorithms in order to facilitate rapid force deployment and reduce the logistics footprint; conflict resolution architectures for multi-agent hybrid systems for robotics and unmanned aerial vehicles (UAVs). In FY05, develop low-order mathematical models of hysteresis nonlinearity to improve the performance and real-time control of smart materials to create 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.	7850	8880	9797	9800
-Optical Technologies. This congressional add supports research on growth, processing, and device analysis of semiconductor materials for sensor, display and laser applications to upgrade Army capabilities in sensing and signal processing. No additional funding is required to complete this project.	970	1312	0	0
-Advanced Target Recognition Using Nanotechnologies. This one year congressional add supported basic research to develop advanced target recognition techniques using nanotechnologies. No additional funding is required to complete this project.	970	0	0	0
Totals	49182	52599	56196	56815

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601102A - DEFENSE RESEARCH SCIENCES						PROJECT H66	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H66 ADV STRUCTURES RSCH	1426	1440	1438	1428	1540	1567	1577	1618

A. Mission Description and Budget Item Justification: The goal of this effort is to provide 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 for the Future Combat Systems and Unmanned Combat Armed Rotorcraft supporting Army Transformation. 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 and aeromechanical stability; 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 in: 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 Unmanned Rotorcraft specific 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 structures basic research within the DoD. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H66

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>In FY02: analyzed delamination and failure models, fatigue life, low velocity impact effects, and flaw size characteristics of structural composite components to reduce the weight and cost for future rotorcraft; investigated advanced technology macrofiber composite actuators for rotor blade twist and vibration control; evaluated the first forward flight performance of a 'closed loop' twist actuated active rotor system; correlated model predictions with wind tunnel experiments to verify significant vibration reductions. In FY03: Perform residual strength predictions for composite sandwich panel damage due to low velocity impact. Establish new industry test standards for hybrid composite delamination. Analyze methodologies to determine the probability of small crack fatigue life for aging Army vehicles. In FY04, assess UAV utility of innovative wing designs inspired by naturally-based morphologies. Analyze potential of actively-controlled rotor stability augmentation model for tiltrotor UAV. Evaluate soft soil and water impact effects on crash occupant survivability. Evaluate durability, damage tolerance, and failure mechanisms for embedded sensors/actuators in flexible structure. In FY05, Investigate static/dynamic characteristics of naturally based morphologies for vehicle wing designs using finite-element modeling. Evaluate advanced concepts for UAV primary flight control and vibration reduction.</p>	1426	1440	1438	1428
Totals	1426	1440	1438	1428

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H67

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H67 ENVIRONMENTAL RESEARCH	3379	3308	1415	1517	829	806	788	883

A. Mission Description and Budget Item Justification: The objective of this project is to focus basic research on innovative technologies for both industrial pollution prevention (P2) that directly supports the Army production base and weapon systems as well as non-stockpile chemical warfare (CW) site remediation. The pollution prevention work invests in next generation manufacturing, maintenance, and disposal methods that will result in significantly reducing the usage of hazardous and toxic substances and their associated costs. The goal is to decrease the overall life-cycle costs of Army systems by 15-30% through the application of advanced pollution prevention technologies. The CW remediation efforts concentrate on the application of biotechnology in the characterization and physical clean up of agent contaminated soils and groundwater and reduced corrosive and more environmentally benign decontamination of biological warfare (BW) agents on field equipment and weapon systems. The goal is to reduce the cost of remediating a site by at least 50% versus the use of conventional methods. CW thrusts include establishing the ecotoxicity of CW compounds, environmental fate and effect of CW compounds in soils and biodegradation of CW compounds. Pollution prevention thrusts include: environmentally acceptable, advanced, non-toxic processes to manufacture lightweight alternative structural materials to enhance weapon system survivability; clean synthesis of more powerful and improved energetic compounds to eliminate the use of hazardous materials and minimize the generation of wastes; and surface protection alternatives to hazardous paints, cadmium, chromium, and chromate conversion metal and composite surfaces. This project is linked to the Army Environmental Requirements Technology Assessment (AERTA) requirements. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is under the direction of the U.S. Army Armament, Research, Development and Engineering Center. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds were provided to the program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
H67

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>In FY02, produced nanocomposites with improved thermal properties. Mechanically tested aqueous processed and spun silk fibers. Measured effect of carbon, hydrogen and carbon migration to gun barrel substrate and further evaluated models associated with cylindrical magnetron sputtering. Characterized 16 natural products bacteriocins. Improvements made to synthesis of CL-20 and Differential Absolute Delay Equalization explosives. Established first ecotoxicological data base for CW agents and developed soil analytical method for HD and VX. In FY03, conduct target meals-ready-to-eat injection molding and biodegradation studies. Characterize variables affecting spin solution fiber properties. Continue longer term measurement of element migration to chrome and tantalum steel interfaces at higher temperatures. Evaluate adhesion of ion beam assisted deposition coatings applied to depleted uranium (DU) coupons. Assess supercritical fluids crystallization. Conduct instrument measurements on actual contaminant samples. Identify enzymatic alternatives in membrane research. In FY04, scale-up prototype nanocomposite materials processes. Assess impact of new nitrogen-rich propellant gases on gun barrel coatings. Survey commercial off-the-shelf corrosion inhibitor post-treatment to close DU penetrator pinholes. Formulate cellulose gel to test on potentially contaminated concrete surfaces. Broaden decontamination studies to include viral surrogates and additional bacterial enzymes. Down select candidate molecular recognition elements and test components for electrical and ionic conductivity. In FY05, Investigate alternative coating systems capable of depositing onto more complex geometries. Conduct nitration studies on intermediates derived from ethylene diamine. Isolate and assess variety of bacteriocins. Incorporate improved detector strains into gel compounds. Test polyelectrolytes for energy storage.</p>	3379	3308	1415	1517
Totals	3379	3308	1415	1517

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
S13

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
S13 SCI BS/MED RSH INF DIS	8810	9177	9579	9613	10080	10260	10414	10669

A. Mission Description and Budget Item Justification: This project supports focused research for healthy, medically protected soldiers for the Objective 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. The cited work is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is managed by the US Army Medical Research and Materiel Command. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
S13

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, achieved a major accomplishment in the fight against malaria by publishing with The Institute for Genomic Research and other consortium members the Plasmodium falciparum malaria genome. Studied new approaches to more effectively and rapidly test malaria vaccines. Discovered potential antimalarial compounds to address the spread of resistance to current drugs; identified mechanisms by which the malaria parasite develops drug resistance; incorporated bioinformatics technology to more effectively search genomic information resulting in discovery of a new target within the malaria parasite. FY03, adapt DNA microarray technology to rapidly screen potential antimalaria drugs and vaccine targets. Identify new malaria drug targets and mechanisms of the parasite's drug resistance; assess the presence of malaria drug resistance in different regions of the world. FY04, identify, using genomic technology, promising new targets to develop for inclusion into new vaccines against P. falciparum and P. vivax. Develop models that can be used for high throughput screening and new drug discovery. FY05, enhance and integrate techniques to exploit genomic information for vaccine and drug discovery efforts.	5415	4638	4825	4845
FY02, investigated new vaccine components and other prevention methods to protect deployed soldiers against diarrheal diseases. FY03, conduct studies of new vaccine additives that enhance the protection induced by anti-diarrheal vaccines. FY04, conduct studies to assess the incidence and types of diarrhea causing agents in areas of deployment to determine suitability as vaccine test sites. FY05, incorporate genomic information into vaccine discovery efforts.	1086	528	508	522
FY02, studied the diversity of dengue virus strains currently causing disease in Indonesia, Thailand, Peru, and Venezuela; identified and generated a DNA-based vaccine against Rift Valley fever; and developed animal model for Hanta pulmonary syndrome. FY03, conduct studies on dengue disease progression; conduct studies to design a combined vaccine against several different hemorrhagic fever and other lethal viruses. FY04, identify alternative approaches to create effective and safe dengue fever vaccine. Identify genes from other lethal viral diseases such as Rift Valley for incorporation into DNA vaccines. FY05, develop field sites for testing dengue and hemorrhagic fever vaccines.	1309	1604	1706	1682
FY02, developed a computerized mosquito identification system for use by military preventive medicine teams to assess risk of exposure. FY03, evaluate insect-borne disease exposure in Central Command region of responsibility. FY04, develop tests to detect, in insects, insect-borne diseases in areas of deployment. FY05, study integrated dengue vector preventive medicine control system in Central and South America and Thailand to evaluate effectiveness.	1000	1248	1338	1338

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
S13

	FY 2002	FY 2003	FY 2004	FY 2005
<p><u>Accomplishments/Planned Program (continued)</u></p> <p>FY03, conduct necessary basic research to define, acquire, and evaluate approaches to provide infectious disease diagnostics to the battlefield; identify microbial DNA sequences that are adaptable to the first generation military common diagnostics system. FY04 identify infectious disease diagnostic components compatible for use in a joint services biological agent identification and diagnostic system. FY05, develop approaches to supplement infectious disease diagnostics not compatible with joint system.</p>	0	1159	1202	1226
Totals	8810	9177	9579	9613

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
S14

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
S14 SCI BS/CBT CAS CARE RS	3860	4001	4204	4222	4401	4482	4563	4672

A. Mission Description and Budget Item Justification: This project supports research for healthy, medically protected soldiers for the Objective 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. Research under this project is conducted at the US Army Medical Research and Materiel Command's Walter Reed Army Institute of Research and US Army the Institute of Surgical Research. The cited work is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
S14

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, identified additives for resuscitation fluids to improve patient response for use by combat medics. FY03, conduct basic research to further enhance resuscitation capabilities of combat medics; define mechanisms of organ injury associated with blood clotting and bleeding; identify additional additives or means to improve patient response to resuscitation fluids. FY04, define measurable combat casualty parameters that can be used as indicators of need for immediate medic intervention vs. delayed intervention. Begin basic research, in collaboration with the National Institute of Health (NIH), conduct conceptual development, technology discovery, and early studies to significantly mitigate or eliminate the impacts of battlefield injury, including severe hemorrhage and other body fluid losses, penetrating head injury, and mutilating soft-tissue and skeletal injury. FY05, define the impact of stabilizing body potassium concentrations on casualty survival. Continue basic research collaboration efforts with NIH.	2288	2732	2878	2872
FY02, investigated means to remotely determine wound severity to maximize medical responder effectiveness on the battlefield; studied gene expression after brain trauma and showed that actions taken in response to specific gene expression may help mitigate brain injury; demonstrated a proof-of-concept that a candidate drug (CGX-1007) protects brain tissue after injury; identified chemical food additives that may help reduce dental disease in deployed warfighters. FY03, study methods for medics to exploit Land Warrior capabilities to remotely diagnose, triage, and treat casualties, evaluate new candidate drugs to preserve brain tissue after penetrating head injury. FY04, define measurable indicators of brain injury severity for use in directing treatment. FY05, evaluate brain cooling as a means to preserve brain tissue and function after penetrating head injury.	1572	1269	1326	1350
Totals	3860	4001	4204	4222

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
S15

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
S15 SCI BS/ARMY OP MED RSH	5290	5500	5721	5740	6031	6137	6227	6381

A. Mission Description and Budget Item Justification: This project supports research for healthy, medically protected Objective Force soldiers, 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 and sustainment and enhance 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 following US Army Medical Research and Materiel Command laboratories conduct research under this project: the US Army Aeromedical Research Laboratory, the US Army Research Institute of Environmental Medicine, and the Walter Reed Army Institute of Research and its overseas laboratories. The cited work is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
S15

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, demonstrated that ultra wide-band radiation causes a prolonged drop in blood pressure in rats. Documented the effectiveness of consuming supplemental carbohydrate beverages to enhance vigilance during simulated combat operations, and began exploration of the interactions of neurotoxins and radio frequency radiation on the central nervous system to identify potential health consequences. FY03, develop a simple eye model to study real-time photoreceptor changes during laser exposure, evaluate models of water requirements, and develop biomedical strategies to reduce water requirements for soldiers in operational environments. FY04, explore the benefits of nutritional supplements to enhance metabolic rate for weight management, cold survival, and cognitive functions. FY05, apply DNA chip technologies to mechanisms and treatment responses to laser eye injury.	1972	1918	1914	1919
FY02, completed preliminary identification of patterns of gene responses in worms exposed to military-relevant reproductive toxins. FY03, explore brain imaging to determine whether increased mental activity aggravates brain changes associated with sleep deprivation. FY04, explore the effect of caffeine activation on sleep processes in a non-human primate to explain fundamentals of sleep in humans. FY05, investigate the use of genomics (study of genes and their functions) and proteomics (study of protein expression and function) to explain individual variability of sleep and performance.	1360	1815	1898	1965
FY02, demonstrated that antifreeze proteins protected skin cells in extreme cold weather operations and calcium reduced organ damage caused by hypothermia. FY03, explore heart rate variability as a predictor of cold injury and identify molecular markers related to altitude adaptation. FY04, explore the effects of prolonged cold exposure on the immune system to determine soldiers' susceptibility to illness. FY05, identify molecular markers of cold acclimation and study the effects of carbohydrate supplements on muscle metabolism at high altitudes to determine their potential value in sustaining soldier performance in high-altitude operations. Explore mechanisms of cell damage that result in performance impairment at high altitude.	1958	1767	1909	1856
Totals	5290	5500	5721	5740

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T22

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
T22 SOIL & ROCK MECH	1775	1882	1950	1960	2031	2067	2098	2150

A. Mission Description and Budget Item Justification: This basic research creates the fundamental knowledge for new construction materials that provide greater ballistic and penetration protection, improved control of the visual, infrared, and radar signatures, and more rapid soil stabilization. This research will improve the physics-based understanding of geologic and structural materials due to dynamic loading. These technologies provide the basis for applied research that supports the civil engineering technologies for deployment, sustainment, mobility, and survivability of the Objective Force in program element 0602784A, project T40. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T22

Accomplishments/Planned Program

Multi-Spectral Technologies for Fixed Facilities - In FY02, produced experimental quantity of electro-chromic material for evaluation as a responsive/passive camouflage, cover, and deception technology. In FY03, evaluate multispectral characteristics of experimental quantities of electro-chromic camouflage, cover, and deception material. Hardened Construction Materials - In FY02, linked improved 3-dimensional penetration curve model (PENCRV3D) for fractured/jointed rock with explicit finite element code (EPIC) projectile response code, and evaluated PENCRV3D against results from instrumented projectile experiments. Performed mechanical property tests on concrete and aggregate specimens and on finite element (FE) meshes that included cubic and spherical aggregates. In FY03, conduct FE simulation of mechanical property tests on concrete specimens by modeling the mortar and aggregate independently. In FY04, conduct FE simulation of dynamic experiments using both homogeneous and heterogeneous modeling techniques. Produce technique for mapping dynamic deformation and cracking in quasi-brittle materials. Pavements Research - In FY02, investigated fundamental soil reinforcement mechanisms for non-traditional stabilization additives. In FY03, complete asphalt dynamic model. In FY04, provide first-generation reinforcement models describing the interaction between soil particles and nontraditional stabilizers. In FY05, mature concept for low-velocity probe that could provide capability to remotely determine soil properties. Vehicle-Terrain Interaction - In FY03, produce physics-based generalized soil theory for large deformations in soil from maneuver operations. In FY04, complete vehicular surface interactive models for Future Combat Systems (FCS). In FY05, delineate a continuum mechanics theory critical to predictive models of vehicle-terrain interaction.

FY 2002	FY 2003	FY 2004	FY 2005
1775	1882	1950	1960
<p>Totals</p>			
1775	1882	1950	1960

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T23

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
T23 BASIC RES MIL CONST	1502	1578	1649	1659	1711	1746	1781	1821

A. Mission Description and Budget Item Justification: This project supports facilities research in forming a fundamental understanding of the long-term durability of composite materials, the behavior of structural elements, and collaborative design theories to support Army Installation Transformation. Seismic Engineering research supports the Army's need to have capability to more easily retrofit those structures that are at seismic risk or at risk of collapse when explosions occur. These efforts provide basic research leading to improved design capability for a range of facilities that optimize facility mission performance, reduce design and construction errors and omissions, meet the users' needs, 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 sustaining of deployed facilities (buildings, etc.) and energy and utility infrastructure. This project supports exploratory development efforts in program element 0602784A, projects T41 and T45. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T23

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Facility Design Improvement and Seismic Engineering – In FY02, investigated ability of collaborative design theory to simulate the design process and product engineering conflict. Also enhanced fundamental micro-mechanical stiffness and strength models of infrastructure fiber reinforced polymer composites for improved ductility of seismic connection. In FY03, investigate algorithms to optimize facility planning/design processes to improve transformation requirements match and increase throughput. Formulate moisture/temperature material property transport models for long-term performance modeling of structural composite materials. In FY04, investigate fundamental thermodynamics and material properties that describe microencapsulated phase change material performance as it affects heat transfer of thermal fluids. Investigate underlying factors affecting the attenuation of electromagnetic fields under intense transient field conditions and develop models for the non-linear response. In FY05, determine fundamental aspects of multi-agent computational modeling as a next generation approach to facility threat protection. Formulate optimization algorithms suitable for rapid and flexible design of the continuum of facilities needed by the objective force.	1502	1578	1649	1659
Totals	1502	1578	1649	1659

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T24

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
T24 SNOW/ICE & FROZEN SOIL	2078	1185	1201	1184	1274	1295	1294	1328

A. Mission Description and Budget Item Justification: This basic research focuses on material characterization, physical and chemical processes, and energy propagation applicable to predicting state of the terrain, the effects of the environment on target and target background signatures, and future mobility enhancements in support of the materiel development community. It thus provides the knowledge base for understanding and assessing environmental impacts critical to battle space visualization. Terrain State research investigates weather-driven terrain material changes and sensing/inferring subsurface properties. Signature Physics research focuses on understanding the dynamic changes to electromagnetic, acoustic and seismic signatures in response to changing terrain state. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T24

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Terrain State and Signature Physics – In FY02, investigated terrain geometry and material properties controlling millimeter-wave signatures as it affects obstacle detection systems. Determined military unique seismic/acoustic signatures to improve sensor target detection and classification in urban areas and snow covered terrain. In FY03, investigate a new modeling approach for snow and other materials to formulate a physics-based theory in support of conceptual vehicle mobility design and performance evaluation. Identify environmental enablers to communication technologies as low-detectability, wireless alternatives to traditional airwave and wire communications. Determine the physical property dynamics related to environmental transitions of electromagnetic signatures in support of model formulation to improve predictions of sensor performance in complex terrain. Investigate sensor fusion strategies to measure aerosolized endospores in complex natural environments in support of remote detection and identification. In FY04, investigate near surface meteorological variables at the micro scale and develop all-season 3-dimensional discontinuous canopy model providing improved modeling for target detection and scene visualization. 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.</p>	1116	1185	1201	1184
<p>Cold Weather Sensor Performance - This one year Congressional Add investigated physical properties of snow affecting microwave extinction for deep snow conditions and frozen ground chemistry affecting the complex dielectric constant of soil. No additional funding is required to complete this project.</p>	962	0	0	0
<p>SBIR/STTR</p>	0	0	0	0
<p>Totals</p>	2078	1185	1201	1184

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T25

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
T25 ENVIRONMENTAL RES-COE	4234	4435	4652	4687	4828	4922	5027	5145

A. Mission Description and Budget Item Justification: Environmental quality basic research investigates 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 program element 0602720A, projects F25, 048, and 896. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T25

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Environmental and Ecological Fate of Explosives, Energetics, and Other Contaminants – In FY02, determined soil invertebrate screening benchmark levels for propellants and explosives to aid in risk-based environmental assessments. In FY03, determine the effects of soil physical and chemical properties on the bioaccumulation and toxicity of explosive contaminants for soil invertebrates such as earthworms to improve the basis for risk-based site assessments of explosive contaminated sites. Determine whether explosive vapors diffuse up through frozen soil as functions of soil temperature and moisture content to improve site characterization. In FY04, determine the chemical, physical, and biological transformation of crystalline explosive residues on firing ranges. Investigate remote techniques for long term monitoring of military unique compounds in the environment. In FY05, determine the molecular toxicology of selected explosive compounds in mammals.</p>	686	1508	1336	1415
<p>Remediation of Explosives, Energetics, and UXO – In FY02, determined mechanisms of adsorption, transformation, and immobilization of explosives and their by-products in soils and groundwater to provide the bases for improved tools for characterizing and treating contaminated sites. In FY03, identify/characterize the types of micro-organisms in the ground to aid in the development and use of biological in situ treatment processes. Describe the fundamental behavior of micro-organisms when introduced into chemical contaminant destruction processes. Show how TNT and TNT transformation products (nitroaromatics) bind to the organic and mineral fractions of soil and identify mechanisms for how the nitroaromatics can be extracted from the soil fractions. Describe the chemical behavior and transport of cyclodextrins and explosive compounds under different environmental regimes for in situ remediation using electrokinetic processes. Determine the response signatures of electromagnetic induction sensors to UXO composed of composite materials to improve detection. In FY04, determine 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 transport of contaminants and to improve treatment processes. In FY05, describe propellant attenuation on ranges via the management of natural soil cycles.</p>	2059	1330	1401	1375

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

PROJECT
T25

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Threatened and Endangered Species – In FY02, formulated theories for acoustic behavior near weapons blast waves for use in predicting noise absorption and mitigating weapons noise. In FY03, evaluate physiological response and habituation of endangered bird species to military stressors to assess relative effects of military training disturbances. In FY04, determine genetic differences in native species of diploid grass populations to enhance resilience for land rehabilitation and map candidate genome traits. Determine the effects of military training noise on the feeding, roosting, and flight behaviors of endangered bats. In FY05, describe physical, chemical, and biological phenomena impacting ecosystem maintenance, mitigation, and rehabilitation for Army lands. Evaluate the degradation of auditory sensitivity for bats due to shock wave pressure.	1489	1597	1915	1897
Totals	4234	4435	4652	4687

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601103A - University Research Sciences (H)						PROJECT D55	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
D55 UNIVERSITY RESEARCH INITIATIVE	0	0	71642	77166	72366	68309	69861	71093

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 will be transferred to the Army in support of the Multidisciplinary University Research Initiative (MURI) and the Defense University Research Instrumentation Program (DURIP). 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 develop 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 the Army Science and Technology Master Plan, the Army Modernization Plan, and supports the Objective Force transition path of the Transformation Campaign Plan. There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601103A - University Research Sciences (H)

PROJECT
D55

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
In FY04: Continue supporting the 43 MURI awards made in prior years. A few key continuing MURI research topics include: Fundamental Issues Underlying Infrared Detection; Ultrawide-band Communications; New Adaptive, Reconfigurable RF Radio/Sensor Concepts; Biological and Chemical Sensing at terahertz Frequency. Continue supporting those PECASE investigators begun in prior years. In FY05: Continue supporting the MURI awards made in prior years. A few key continuing MURI research topics include: Intergrated Control and Communication for Networked Systems; Mathematics of Failures in Complex Systems; Fundamental Theoretical/Experimental Molecular Science for Design of Fuel Cell Systems. Continue supporting those PECASE investigators begun in prior years.	0	0	42942	44966
In FY04: Initiate approximately 14 new MURI awards. Topics for the FY04 MURI research competition will be selected in strategic basic research areas related to transformational and high-priority Army Force Operating Capabilities such as sensor fusion, beyond-line-of-sight lethality, countermeasure, deployability and survivability. Potential new multidisciplinary topics could include Control of Biologically Inspired Mobile Networks (swarms) of Autonomous and Semi-Autonomous Vehicles; or Modeling the Effects of Training on Performance and Readiness. Two new competitive awards will be made under the PECASE program. In FY05: Initiate approximately 18 new MURI awards. Topics for the FY05 MURI research competition will be selected in strategic basic research areas related to transformational and high-priority Army Force Operating Capabilities such as sensor fusion, beyond-line-of-sight lethality, countermeasure, deployability and survivability. Two new competitive awards will be made under the PECASE program.	0	0	14000	16700
In FY04: Competitive grants will be awarded for the acquisition of research instrumentation. Emphasis is on instrumentation vital to the discovery of new science and the advancement of Army transformational technologies. Research instrumentation awards average approximately \$150K each. In FY05: Competitive grants will be awarded for the acquisition of research instrumentation. Emphasis is on instrumentation vital to the discovery of new science and the advancement of Army transformational technologies.	0	0	14700	15500
Totals	0	0	71642	77166

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601103A - University Research Sciences (H)

PROJECT
D55

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget	0	0	0	0
Current Budget (FY 2004/2005 PB)	0	0	71642	77166
Total Adjustments	0	0	71642	77166
Congressional program reductions				
Congressional rescissions				
Congressional increases				
Reprogrammings				
SBIR/STTR Transfer				
Adjustments to Budget Years			71642	77166

Significant Changes:

FY04 - PE devolved from OSD to Army; Funds investments in Multidisciplinary University Research Initiative (MURI) and the Defense University Research Instrumentation Program (DURIP).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	71699	83310	84816	79750	78817	82389	84355	86227
H50 COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	7371	7608	8205	8321	9132	9903	10144	10376
H53 ADV DIS INTR SIM RSCH	2408	2472	2563	2535	2723	2769	2836	2901
H54 ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	5661	5891	6429	6566	7401	8192	8392	8583
H56 ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5616	5759	6217	6274	6766	7233	7409	7579
H59 UNIV CENTERS OF EXCEL	18525	11414	20268	16846	17100	17320	17702	18054
H62 ELECTROMECH/HYPER PHYS	7410	6716	5869	5743	6027	6251	6356	6458
H64 MATERIALS CENTER	1919	2757	2357	2449	2564	2718	2785	2847
H65 MICROELECTRONICS CTR	820	939	972	961	984	1073	1099	1124
H73 NAT AUTO CENTER	2853	5359	3038	3064	3153	3212	3289	3363
HA1 GLOBAL INFORMATION PORTAL	963	0	0	0	0	0	0	0
HA2 THERMAL FLUID DESIGN TOOL	942	0	0	0	0	0	0	0
HA3 VIRTUAL PARTS ENGINEERING RESEARCH CENTER	958	0	0	0	0	0	0	0
HA5 CENTER FOR OPTICS MANUFACTURING	1439	0	0	0	0	0	0	0
HA6 ARMOR MATERIALS DESIGN - LASER-BASED MATERIAL PROC	0	1191	0	0	0	0	0	0
HA7 DENDRIMER NANOTECHNOLOGY RESEARCH	0	3337	0	0	0	0	0	0
HA8 FERROELECTRIC MATERIALS NANOFABRICATION	0	953	0	0	0	0	0	0
HA9 JIDOKA PROJECT	0	1431	0	0	0	0	0	0
J08 INSTITUTE FOR CREATIVE TECHNOLOGY	9284	12236	12101	11345	7383	7373	7599	7816
J09 POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5530	5739	5952	5894	5874	5857	6001	6138
J12 NANOTECHNOLOGY	0	9508	10845	9752	9710	10488	10743	10988

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

A. Mission Description and Budget Item Justification: This program element leverages research in the private sector through Collaborative Technology Alliances (CTA), Centers of Excellence, and the University Affiliated Research Centers. A significant portion of the work performed within this program directly supports Objective Force requirements by providing the enabling technologies which will make development of Objective Force equipment possible. CTAs are innovative alliances among government, industry and academic organizations to exploit scientific and technological breakthroughs and to transition these breakthroughs to exploratory development and applied research. 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, which 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 and rotary wing technology. Also included is eCYBERMISSION, the Army national web-based competition to stimulate interest in science, math and technology in middle school students. This program element also includes the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN will emphasize revolutionary materials research for advanced soldier protection and survivability. A Biotechnology Center of Excellence will be established in FY03. The Army's Institute of Creative Technologies (ICT) is also included in this program element. The ICT is a partnership with academia and the entertainment industry 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	73054	74855	70487	71211
Current Budget (FY 2004/2005 PB)	71699	83310	84816	79750
Total Adjustments	-1355	8455	14329	8539
Congressional program reductions		-1800		
Congressional rescissions		-1248		
Congressional increases		14376		
Reprogrammings	601	-479		
SBIR/STTR Transfer	-1956	-2394		
Adjustments to Budget Years			14329	8539

Change Summary Explanation: Funding - FY2004/ FY 2005: Funds increased to support the Robotics CTA, Biotech Center, eCYBERMISSION, and the Institute for Creative Technologies.

FY03 Congressional Adds:

Armor Materials Design – Laser-based material processing, Project HA6 (\$1250); Composite Materials Center of Excellence, Project H64 (\$826); Dendrimer Nanotechnology Research, Project HA7 (\$3500); Institute for Creative Technologies, Project J08 (\$1500); NAC University Automotive Research Coalitions, Project H73 (\$2800); Ferroelectric materials nonfabrication, Project HA8 (\$1000); Jidoka Project, Project HA9 (\$1500).

Project with no R-2A:

Project H65 (\$944)- Microelectronics Center of Excellence: This program allows the Army to leverage extensive scientific manpower and knowledge of the universities to conduct innovative research and exploit new concepts in solid state physics, electrical engineering, photonics, microelectromechanical systems (MEMS) and the use of chemical/electrochemical engineering to produce microelectronic devices to support specific Army needs.

Project HA6 (\$1198)- Laser-based Material Processing. The purpose of this one year congressional add is to develop novel material and processing technologies such as friction stir welding, laser materials design and fabrication, free form rapid prototyping, and computer based simulations materials design in support of the Army's missile and helicopter programs. Implemented by the University of Missouri at Rolla. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

Project HA7 (\$3356)- Dendrimer Nanotechnology Research. The objective of this one year Congressional Add is to focus on novel synthesis and scale-up of dendritic polymers for Army applications. No additional funding is required to complete this project.

Project HA8 (\$958): Ferroelectric materials Nonfabrication. The objective of this one year Congressional Add is to explore advanced approaches for ferroelectric materials synthesis and development. No additional funding is required to complete this project.

Project HA9 (\$1439): Jidoka Project. The objective of this one year Congressional Add is to research ways to maximize autonotation to improve the quality of automotive production. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT H50			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H50 COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	7371	7608	8205	8321	9132	9903	10144	10376	

A. Mission Description and Budget Item Justification: This project supports a competitively selected university/industry consortium, the Collaborative Technology Alliance (CTA) that was formed to provide solutions for the Army's requirements for robust, survivable, and highly mobile wireless communications networks. The Objective 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; tactical information protection. The results of this work will significantly affect Objective Force communications/networking development efforts. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H50

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- 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 FY 02, investigated energy -efficient routing, transmission scheduling, and neighbor discovery protocols for directive antennas. Established formal models for routing protocols to systematize performance evaluation. In FY 03, investigate and assess routing, media access control, and auto configuration algorithms to enable energy -efficient communications for mobile networks. In FY 04, integrate self-organizing and auto configuring subnet protocols that enable persistent on-the-move communication sessions in highly mobile conditions. In FY 05, validate self-organizing and auto configuring subnet protocols that enable persistent on-the-move communication sessions in highly mobile conditions.	2583	2665	2828	2860
- 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 FY 02, investigated and assessed Multi-Input Multi-Output broadband non line of sight communications that showed major improvement in performance in noisy environment. In FY 03, investigate and assess multiple access and advanced modulation schemes that enables communications under dynamic wireless conditions. In FY 04, conduct analytical and experimental studies investigating high performance multiple access techniques and high spectral efficiency modulation schemes for communications on the move. In FY 05, conduct analytical and experimental studies validating high performance multiple access techniques and high spectral efficiency modulation schemes for communications on the move.	1842	1882	2070	2100
- 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 FY 02, investigated robust coding schemes that mitigate interference and jamming that shows improved processing gain with reduced transceiver complexity. In FY 03, investigate and assess low probability of detection waveforms and interference mitigation techniques. In FY 04, conduct 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 FY 05, 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.	1473	1560	1656	1675

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H50

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Tactical Information Protection: perform research in scaleable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY 02, investigated novel approaches to autonomously distribute trust credentials without reliance on central authority and for self-authenticating key management where significant reductions in bandwidth and latency were shown. In FY 03, investigate and assess trust establishment, key management, and intrusion detection techniques for very resource-constrained and highly mobile ad hoc networks. In FY 04, conduct analytical and experimental studies investigating a highly efficient and noise robust security suite with distributed trust, distributed key management, and intrusion detection. In FY 05, conduct analytical and experimental studies validating a highly efficient and noise robust security suite with distributed trust, distributed key management, and intrusion detection.	1473	1501	1651	1686
Totals	7371	7608	8205	8321

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT H53			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H53 ADV DIS INTR SIM RSCH	2408	2472	2563	2535	2723	2769	2836	2901	

A. Mission Description and Budget Item Justification: This project supports a long-term collaboration between the Army Research Laboratory and a competitively selected Army Center of Excellence in Information Sciences (ACEIS). The objective of the center is to perform research in information technology in support of mobile command and control for the Objective force. Implementation and integration of future command and control system Commander/User requirements with architectures which utilize distributed enterprise database methodologies are the most significant technical barriers. Areas of emphasis include interactive and intelligent systems, database and information systems, and distributed and parallel processing systems. A major portion of the work of the ACEIS is performed at the Clark Atlanta University, a HBCU institution. This project also supports Army critical research at the Army High Performance Computer Research Center focused on the Objective Force, including: neutralizing the effects of airborne and ground-borne contaminant transport, structural response of armored vehicles to perforating and nonperforating projectiles, investigating more efficient gun projectile and missile propulsion systems, and evaluating materials suitable for armor/anti-armor applications. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program/project.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Perform research into information exchange and retrieval systems that enhance information fusion on the battlefield to improve knowledge management for mobile command and control. In FY 02, designed laboratory experiments on battlefield data exchange and performed user experiments on intelligent retrieval. In FY03, evolve analytical database techniques to query different databases for pertinent information. In FY04, perform experiments on distributed databases using intelligent agent technologies; and in FY05, test information retrieval agent techniques on databases used in battlefield situations.	729	751	835	866

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H53

Accomplishments/Planned Program (continued)

- Perform research, at the Army High Performance Computing Research Center (AHCRC), that requires computationally intensive algorithms in the areas of projectile target interaction, signature modeling, and enabling technologies to include scientific visualization that supports the Objective Force transition path. In FY02, applied intelligent processing techniques in composite manufacturing, improved portability of portioning algorithms for use in the design of Army combat platforms, and analyzed principles of simulation based design to effect reductions in cost & time of fielding the Objective Force. In FY03, apply computational tools, such as data mining, to test data and extract patterns useful for the design of components and apply scalable, dynamic partitioning methods in the design of lightweight structures for the Objective Force. By FY 2004-2005, mature computational tools to influence the use of novel materials and ultra-lightweight structures in system designs for the Objective Force.

FY 2002	FY 2003	FY 2004	FY 2005
1679	1721	1728	1669
2408	2472	2563	2535

Totals

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT H54			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H54 ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	5661	5891	6429	6566	7401	8192	8392	8583	

A. Mission Description and Budget Item Justification: This project supports a competitively selected industry/university consortium, the Collaborative Technology Alliance (CTA), for the purpose of leveraging world-class research relevant to the needs of the Objective Force and Army Transformation needs. This CTA links a broad range of government technology agencies and industry/academia partners with ARL. The CTA conducts innovative research focusing on three main technical areas: micro sensors, electro-optic smart sensors, and advanced radar concepts to support the Objective Force's requirement for advanced sensing technologies. The technical areas addressed under this project include overcoming technical barriers associated with: autonomous calibration and management of micro sensor networks; multidomain smart sensors (includes multispectral infrared focal plane arrays); a novel concept for 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 cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- In FY02, completed a novel algorithm for automatically detecting and tracking multiple objects in a video image. In FY03, perform microsensor research focused on sensors, algorithms, low-power signal processing, and autonomous sensor/network management for the unattended sensor network component of FCS. In FY04, evaluate 100x reduction of sensor network power budget. In FY05, complete self-calibrating sensor fields.	2258	2313	2576	2622
- Perform electro-optics research focused on infrared sensors, ladar, hyperspectral imaging, and automatic target recognition algorithms for improved situational awareness and targeting by FCS platforms. In FY02, transitioned custom-designed two-color infrared sensor array to CECOM/NVESD for the mine detection program. In FY03, quantify new material for high-performance infrared hyperspectral imager. In FY04, demonstrate and characterize separate passive infrared imager and active ladar imager. In FY05, demonstrate prototype integrated active/passive imager	1988	2075	2251	2288

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H54

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- 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 FY02, completed and evaluated production of prototype low-cost phase control modules for electronically scanned antennas planned for FCS platforms. In FY03, fabricate and demonstrate a prototype lens/filter array for radar beam steering. In FY04, complete electronically scanned antenna subsystem comprised of low-cost phase control modules. In FY05, prove out low-power MEMS phase shifters for electronically-scanned antennas.	1415	1503	1602	1656
Totals	5661	5891	6429	6566

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT H56			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H56 ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5616	5759	6217	6274	6766	7233	7409	7579	

A. Mission Description and Budget Item Justification: This project supports a new consortium, a competitively awarded Collaborative Technology Alliance (CTA) which began in FY2002. This CTA, which links a broad range of government technology agencies and industry/academia partners with ARL, conducts innovative research to support the Objective Force's requirement for state-of-the-art information technology applications for responsive situational awareness, distributed commander-staff-subordinate collaboration, and planning and execution monitoring in a high tempo, high stress environment. The objective of the CTA is human-centered, automated support of individual and distributed team information processing and decision-making to achieve information dominance and decision supremacy. 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 cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP). No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H56

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers). In FY02, matured an architecture for integrating diagrammatic representation with conceptual representations to support a CDR's reasoning about events on the battlefield and enhanced a Java-based Multi-Criterial Viewer for examining trade-offs among alternative courses of action (COAs). In FY03, identify key effects on the military decision process of transitioning from plan-centric to intent-centric command and control. In FY04, devise basic architecture for allowing the actions of intelligent agents to be influenced by commander's critical information requirements and OPTEMPO. In FY05, establish guidelines for Command and Control (C2) of intelligent agents to allow the Army to perform C2 functions better and faster than our opponents in conflicts of any intensity under any conditions.	2042	2061	2281	2305
- 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 FY02 investigated Cognitive Task Analysis for Brigade and Battalion command and control. Conducted studies to understand why operators inaccurately perceive area in maps to design displays that improve decision-making. In FY03, create guidelines and tools to support collaboration and decision making in co-located and distributed teams. In FY04, evaluate cognitively based methods and procedures for improved situation awareness and team collaboration and decision making in a distributed environment. In FY05, extend this evaluation to include effective collaborations among human team members and between these teams and intelligent system aids designed to support Objective Force command and control.	1120	1186	1233	1240
- User-adaptive interfaces: explore ideas, frameworks, and technologies which assist the soldier in understanding, problem solving, planning and decision-making. In FY02, completed a new architecture to support sharing and distributing visual data across multiple displays adapting to each display's capabilities. In FY03, improve methods of displaying relevant information in different modalities. In FY04, evaluate prototype display architecture for enhancing situation awareness among co-located and distributed teams. 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.	1527	1540	1682	1692

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H56

	FY 2002	FY 2003	FY 2004	FY 2005
<p><u>Accomplishments/Planned Program (continued)</u></p> <p>- Auto-adaptive information presentation: investigate how to make autonomous machines team players with their human partners or supervisors in war fighting operations. In FY02, identified modifications in UAV command and control tasks so that research on team cognition provides relevant solutions to army unmanned aerial vehicles, Hunter and Shadow. In FY03, determine new forms of feedback. In FY04, evaluate cross adaptation architecture in which all agents contribute to, test and repair a common ground about intentions and assessments and future activities. In FY05, validate baseline system for improving the flexibility of FCS through dynamically reconfigurable software agent systems.</p>	927	972	1021	1037
Totals	5616	5759	6217	6274

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT H59			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H59 UNIV CENTERS OF EXCEL	18525	11414	20268	16846	17100	17320	17702	18054	

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 in Army Transformational areas. Army Centers supported within this project are the Rotorcraft Center of Excellence, a Collaborative Technology Alliance in Robotics, a Biotechnology Center of Excellence to be established in FY03, and HBCU/MI Centers of Excellence in areas of critical research for Army Transformation. This program element funds eCYBERMISSION, a web-based science, math and engineering (SME) competition designed to stimulate interest and encourage advanced education in these areas among middle school students nationwide. 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; by advancing perception and intelligent control research for robotics, and by raising the visibility of the Army's commitment to America's youth and their pursuit of science and mathematics. In FY02, the Institute for Soldier Nanotechnologies at Massachusetts Institute of Technology was established, emphasizing revolutionary materials research toward advanced soldier protection and survivability capabilities. In FY03 and beyond, the nanotechnology program is funded in 61104/J12. The project also 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 soldiers and civilians for the Army workforce of tomorrow. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H59

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- eCybermission national competition to stimulate interest in SME in middle schools. In FY02 completed concept development and conducted regional Beta Test for seventh and eighth grade students. In FY03, launch eCYBERMISSION for seventh and eighth grade students nationwide. In FY04, conduct full-scale launch of competition to all middle school students across the country. In FY 05, sustain eCYBERMISSION and implement enhancements as necessary based on previous years' lessons learned.	6077	4325	4955	4915
In FY04, establish an HBCU/MI center of excellence in a transformational research area such as optimizing cognitive readiness under combat conditions, biowarfare countermeasures, and others. Intent is to leverage as much as possible research carried out at the Army's Institute for Creative Technologies (modeling and simulation), at the Institute for Soldier Nanotechnologies (protective materials); and at the Army's biotechnology center (health and performance). In FY05, establish technology transition teams with industry, Army labs, and the Army user to rapidly transfer research results to application.	0	0	2477	2556
- Robotics Collaborative Technology Alliance: In FY02 Devised algorithms necessary to enable adaptive tactical behaviors in diverse, complex environments and accelerated image science research to develop algorithms for cluttered, highly dynamic scenes to improve real-time robotic perception. In FY04 conduct basic research in perception and control technology to permit future development of algorithms that enable unmanned systems to possess adaptable tactical behaviors. In FY05 prove initial perception and control technology and transition to semi and near autonomous robotic technology programs.	2279	0	2477	2556
- In FY03, establish an Army center for research in biotechnology to harness the enormous new opportunities that exist between the biological and non-biological sciences. In FY04 identify novel biocomputation approaches to information processing, using information content of macromolecules and their interactions, self-assembly processes for molecular manufacture of ultra-high density EMO materials. In FY05, identify photodynamic protein-based molecular memory for rapid and accurate information processing and storage, and biologically derived and biologically inspired synthesis and processing for enhanced performance materials properties.	0	4756	8423	4915

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
1 - Basic research	0601104A - University and Industry Research Centers		H59	
<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- Rotorcraft Centers of Excellence. In FY02, investigated vibration mechanisms and established reduction concepts in level and maneuvering flight. Investigated transmission design for robust diagnostics and prognostics. Established carefree maneuvering control laws for rotorcraft. Investigated deformable wake dynamics for maneuvering flight simulation. Investigated warping actuation of rotor blades by using active material. In FY03, establish semi-active damping control concepts for rotor systems. Develop innovative concepts for micro-rotorcraft or small UAV. Investigate aeromechanical stability and whirl flutter using blade-embedded elastomeric mass dampers. Conduct simulations of unsteady flow rotor interactions to predict dynamic loading in a turbulent environment. Develop passive noise reduction blade design concepts using Computational Fluid Dynamics. In FY04, investigate elastically tailored smart composite rotor blades. Investigate innovative design, and conduct fundamental analysis of micro-rotorcraft and UAVs. Develop a smart materials based actively conformable rotor airfoil. Investigate passive and semi-active reduction concepts of gearbox vibration and noise. Investigate 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. Develop experimental and computational analysis capabilities on rotor wakes and tip vortices.</p>	1800	1879	1936	1904
<p>- Established a University Affiliated Research Center to advance soldier survivability nanotechnology. Seven teams have been formed to research energy absorbing materials, mechanically active materials, devices and exoskeletons, sensors and chemical/biological agent protection, soldier medical technology, material processing and fabrication, modeling and simulation, and outreach and teaming. This program is now funded in Project J12.</p>	8369	454	0	0
Totals	18525	11414	20268	16846

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT H62			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H62 ELECTROMECH/HYPER PHYS	7410	6716	5869	5743	6027	6251	6356	6458	

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, testing 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 to achieve extended rail life, and on establishing the utility of hypervelocity projectiles. 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 Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- Research underpinning technologies for EM gun pulsed power. In FY02, conducted component trials for alternative EM pulsed power options; and investigated the utility of optically triggered switches. In FY03, validate alternative EM pulsed power options and validate advanced switch technology, including SiC and optical triggering for EM. In FY04, perform experiments to establish utility of inductive pulsed power systems and perform experiments to establish performance of high power switches. In FY05, experimentally validate improved high strength, high conductivity field coil material.	1700	1704	1710	1000

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H62

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
- Solve technical barriers associated with hypervelocity EM gun launch. In FY02, devised solutions for armature transition using the C-armature; evaluated candidate laboratory launcher and launch packages for further technology maturation; and proved advanced material and structural components of launcher and launch packages required for future field applications. In FY03, prove advanced integrated launch packages and muzzle shunt operation over the full range of velocities. In FY04, establish performance of non-transitioning EM launch package armatures and define improved materials to solve technical barriers to EM launch. In FY05, provide complete model of electromagnetic, structural, and thermal processes in EM launch.	2500	2165	1500	1000
- Research advanced technologies for hypervelocity target defeat. In FY02, proved robust EM gun penetration lethality against advanced targets. In FY03, prove robust EM gun novel kinetic energy penetration lethality against advanced targets. In FY04, launch a robust novel kinetic energy penetration from an EM gun. In FY05, numerically establish optimal EM novel kinetic energy penetration concept and transition to EM Gun Technology Program.	2500	2132	2109	2943
- Define integration approaches for EM gun technologies on future platforms. In FY02, devised an approach to power sharing architecture for EM guns on hybrid electric vehicles. In FY03, construct mobile power architecture experimental capability. In FY04, define key parameters relating to EM gun integration on a hybrid electric vehicle. In FY05, construct the methodology for end to end simulation of a virtual EM gun fighting vehicle.	710	715	550	800
Totals	7410	6716	5869	5743

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H64

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H64 MATERIALS CENTER	1919	2757	2357	2449	2564	2718	2785	2847

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, U. Massachusetts, U. Maryland-College Park, U. Minnesota, U. Pennsylvania, Tuskegee U. and Howard U. 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 Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H64

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>-In FY02, devised models of energy dissipation mechanisms in lightweight armors during ballistic impact; synthesized materials for ultra-light weight personnel extremities protection systems. Produced ceramic armor materials and devised computer techniques to model graded metal matrix composites in dynamic failure environments. In FY03, enable creation of lightweight structural and ballistic protective materials for Objective Force platforms. In FY04, devise techniques to exhibit improved electrical, optical, and power-generating properties to enable multi-functional capabilities for Objective Force platform survivability; devise theory and design criteria for generating hybrid materials and conduct experimental studies to verify models and show benefits for Objective Force Warrior applications; and devise processing of nano-scale metallics and ceramics envisioned for use in Objective 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.</p>	1919	1970	2357	2449
<p>- The objective of this one year Congressional Add is to enhance the fundamental composite materials research ongoing at the University of Delaware. No additional funding is required to complete this project.</p>	0	787	0	0
Totals	1919	2757	2357	2449

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H73

COST (In Thousands)	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
H73 NAT AUTO CENTER	2853	5359	3038	3064	3153	3212	3289	3363

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), located at 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 on-going and new programs in automotive research, resulting in significant cost savings while maximizing technological achievement. The goal of this PE is to significantly enhance the Army's transformation to the Objective Force by the application of advanced vehicle technologies. This goal will be accomplished through the insertion of leap ahead technologies in phased improvements over the next several decades. The research performed in this PE will contribute to formulating these leap ahead technologies. The selected university partners include: University of Michigan, University of Wisconsin, Wayne State University, University of Alaska, University of Tennessee, and Clemson University, while key industry partners include the major U.S. automotive manufacturers and suppliers.. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance.. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP). No Defense Emergency Response Funds (DERF) were provided to the program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
H73

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Automotive Research Center (ARC) - The goal of this effort is to advance state-of-the-art simulation and modeling of future Army automotive technologies, with strong emphasis on targeting the Army's FCS program. The ARC will also formulate and evaluate future advanced automotive technologies relative to future FCS vehicular platforms. In FY02: Conducted significant fundamental formulation and validation of advanced ground vehicular modeling and simulation algorithms for potential use in FCS. In FY03: Complete final validation and implementation of future FCS mobility and propulsion predictive algorithms, and initiate optimization of the overall Army ground vehicle simulation network. In FY04: Complete final optimization of the Army's overall ground vehicle simulation network and implement a mathematical framework capable of accepting modular subroutines in all generic automotive areas. Evaluate and analyze systems for intelligent remote monitoring, guidance, and control to be used for unmanned autonomous and semi-autonomous FCS ground vehicles. Integrate newly developed advanced automotive technology algorithms within the overall simulation network. FY05: Evaluate and analyze models suitable for ground vehicle design decisions relative to collision avoidance warning systems, rollover warning, active yaw control, path departure, and wireless intelligence systems.	2853	2699	3038	3064
- The purpose of this one year Congressional Add is to conduct basic research in the area of military and commercial ground vehicle modeling and simulation. The eight university consortium consists of Michigan, Wayne State, Oakland, Alaska, Iowa, Wisconsin, Clemson and Tennessee. No additional funding is required to complete this project.	0	2660	0	0
Totals	2853	5359	3038	3064

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers						PROJECT J08	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
J08 INSTITUTE FOR CREATIVE TECHNOLOGY	9284	12236	12101	11345	7383	7373	7599	7816

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 will actively engage 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 will also work with creative talent from the entertainment industry in order to adapt their concepts of story and character to increasing 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 will revolutionize 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. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
J08

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Conduct basic research in immersive environments 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 FY02, created integration techniques for using several cues in immersive environments including virtual humans, 3D sound, and visual media, and specified the architectures for several proof of concept test beds. In FY03, design the constructs for the test beds and specify the possible content media including photo-realistic structures, primary and background sound cues, and odors, and test the integration techniques and media for proper synchronization and identify shortfalls. In FY04, complete the specification of algorithms and architecture constructs for the proof of concept test beds and address computational efficiency and stability issues, develop new techniques to enhance 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.</p>	6023	5367	5932	6000
<p>- Conduct basic research in the two most 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 FY02, created and refined algorithms for attaching dynamic audio objects in synthetic environments (e.g., helicopter sounds). In FY03, improve fidelity of rendering techniques for compositing real objects into virtual environments and achieve matching lighting effects including shadows and bounced light, and extend audio processing algorithms to permit two participants in a given training setting to experience proper sound cues based on their positions relative to the sound sources. In FY04, develop computationally efficient techniques for applying global illumination to synthetic objects. Extend research into second order effects of natural lighting on real persons in synthetic environments. In FY05, extend the concept of virtual loudspeakers to address multiple participants in a given mixed reality setting. Examine sound cancellation techniques to improve auditory cues in noisy environments. Combine new lighting techniques and sound algorithms to make preliminary assessment of their combined impact on immersion.</p>	1800	1666	2634	2633

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
J08

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Conduct research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness. In FY02 , created a novel technique for permitting arbitrary animation of synthetic characters. This provides more realistic movement of computer-generated characters used in simulations and training applications. In FY03, 1) investigate the synchronization of speech and gesture in virtual characters to address non-verbal aspects of communications, and 2) advance speech understanding and text-to-speech processing to permit human to computer interactions in noisy environments. In FY04, complete 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. Conduct 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. Integrate emotional models and timing constraints into the draft specification.	1461	1867	3535	2712
- The objective of this one year Congressional Add is to conduct basic research in immersive environments to achieve efficient and affordable training and modeling simulation solutions at Fort Sill. No additional funding is required to complete this project.	0	3336	0	0
Totals	9284	12236	12101	11345

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT J09			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
J09 POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5530	5739	5952	5894	5874	5857	6001	6138	

A. Mission Description and Budget Item Justification: This project supports a 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 research relevant to Army needs. Power and energy research supporting 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 Combat Systems vehicles and robotic platforms. Technical barriers include overcoming energy density limitations of traditional electrochemical portable power sources, reforming of logistics fuels to generate reformatted fuel for fuel cells, and reducing the size and weight of electric power components and systems. This project was competitively awarded in FY2001. 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 Objective Force. The research in pulsed power and hybrid electric is done in coordination with TARDEC. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
J09

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- Research, investigation and characterization of a micro electro mechanical system (MEMS) based micro-gas turbine generator for producing electricity for the dismounted soldier for the Objective Force Warrior and beyond. In FY02, high-speed turbo operation has been achieved and the 1st generation magnetic generator has been tested. In FY03, operate the micro gas turbine using hydrogen as fuel. In FY04, design 2nd generation non-magnetic generator, turbine film cooling and test hydrocarbon-fueled turbojet. In FY05, provide the first hydrocarbon fueled turbojet.	2143	2243	2308	2304
- Research, investigation and characterization of novel fuel cells/components and logistic fuel reformation techniques for producing electricity for the dismounted soldiers for the Objective Force Warrior as well as producing electricity for vehicle prime power and accessory power for the Future Combat System. In FY02, completed the design and initial prototype of a 1 W direct methanol fuel cell system. In FY03, complete and evaluate the design of a methanol fuel processor feeding a high-temperature fuel cell. In FY04, design and test 10W steam-reformed-methanol hydrogen generator for an elevated temperature fuel cell. In FY05, the direct methanol fuel cell design will be extended to 20W; in addition, optimized processes for the conversion of logistics fuel cells to hydrogen for fuel cell and other uses will be evaluated.	1780	1835	1912	1885
- Research in support of the FCS program by reducing the size and weight of the electronic components and increasing their efficiency by replacing silicon semiconductor devices in the electronic systems and subsystems with those made from silicon carbide. In FY02 identified the breakdown voltages and currents that will have to be achieved to meet the demands in various converter circuits. In FY03 determine the benefits of replacing silicon diodes with silicon carbide diodes in DC - DC converter circuits used for electromagnetic armor and electro-thermal chemical guns, and in matrix converters for on-vehicle power conversion and conditioning. In FY04, determine the benefits of replacing silicon switches with silicon carbide switches in DC-DC converter circuits used for electromagnetic armor and electro-thermal chemical guns, and in matrix converters for on-vehicle power conversion and conditioning. In FY05, determine the benefits of replacing silicon diodes and switches with those made from silicon carbide and demonstrate this in various converter circuits.	1607	1661	1732	1705
Totals	5530	5739	5952	5894

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601104A - University and Industry Research Centers					PROJECT J12			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
J12 NANOTECHNOLOGY	0	9508	10845	9752	9710	10488	10743	10988	

A. Mission Description and Budget Item Justification: This project supports nanotechnology research for the soldier at Massachusetts Institute of Technology Institute for Soldier Nanotechnologies (ISN). The ISN will emphasize revolutionary materials research toward advanced soldier protection and survivability. ISN will work in close collaboration with industry, the Army's Natick Soldier Center (NSC), the Army Research Laboratory (ARL) and other Army Research Development and Engineering Centers (RDECs) in pursuit of its goals. The institute is designated as a University Affiliated Research Center (UARC) to support the Army Objective Force war fighter through research to develop nanometer-scale science and technology solutions for the soldier. This research will emphasize revolutionary materials research toward an advanced uniform concept. The uniform will integrate a wide range of functionality, including ballistic protection, responsive passive cooling and insulating, screening of chemical and biological agents, chameleonic color changes, biomedical monitoring, and extremities protection. The objective is to lighten the soldier's load through system integration and multifunctional devices while increasing his survivability and lethality. Computational models will be developed that predict the soldier's performance with the new technologies. The new technologies will be compatible with the other 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. These technologies are fundamental elements required to realize the Army Transformation and support the Objective Force. Funding for this program was begun in FY02 in Project H59. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) have been provided to this program/project.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- In FY03, initiate research to develop mechanical behavior models of high performance fabrics to provide fundamental understanding of energy absorbing materials. - In FY04, conduct research on nano-based materials and membranes for individual climate control. - In FY05, develop innovative processes and techniques to construct high performance fabrics and multi-layered composite materials.	0	1882	2000	2000
- In FY03, devise high power, high force nanostructures polymer actuators utilizing promising properties exhibited by carbon nanotube technology. - In FY04, integrate actuators with sensors with the goal of improving upon force achieved by human muscle. - In FY05, investigate biomimetic muscle behavior with potential to provide new approaches to outperform natural systems.	0	3706	3845	4000

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

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

PROJECT
J12

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- In FY03, research semi-permeable membranes for chemical and biological protection capable of being integrated into a multi-functional fabric system.	0	3920	4000	3752
- In FY04, investigate techniques and membranes for water purification/filtration.				
- In FY05, develop variable stiffness materials with goal of 100-fold change in stiffness for use in physiological protection (e.g. field applied splints).				
- In FY04, establish a media link. Transition research results of initial nanostructured materials to Army and industrial partners.	0	0	1000	0
- In FY05, Develop fiber fabrication techniques for materials that provide ballistic, climate, physiological, stealth and chemical biological agent protection for the individual soldier. Develop manufacturing processes for integrating multi-functional properties into textiles and materials.				
Totals	0	9508	10845	9752

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601105A - Force Health Protection				PROJECT D52			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
D52 FORCE HEALTH PROTECTION	0	0	9847	9796	9948	10657	10814	11034

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 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 5 thrust areas: (1) global health monitoring, (2) health behavior interventions, (3) health risk communication, (4) health risk assessment methods, and (5) medical materiel safety. The US Army Research Institute of Environmental Medicine, a subordinate element of Army Medical Research and Materiel Command, conducts research under this project. Additional contributors include Naval Health Research Center, San Diego, California, University of Michigan, Ann Arbor, Michigan and University of Texas, Southwestern Medical Center, Dallas, Texas. The cited work is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and supports the Objective transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this program or project.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
FY04, conduct second survey of the Millennium Cohort Study, similar to the classic Framingham heart study, as well as study predictors that lead to "chronic multisymptom illness." This illness encompasses both psychological and physiological symptoms. FY05, revise Recruit Assessment Profile survey instrument to include the most valid predictors of wellness and warfighter resilience.	0	0	2000	2000
FY04, evaluate 12-month follow up results for recruit smoking cessation study. FY05, validate research findings linking the condition described as "chronic multisymptom illness" with specific functional neuroimaging-based neurochemical changes in soldiers.	0	0	2500	2500
FY04, explore relationship between physical activity and prevention or treatment of the chronic condition described as "chronic multisymptom illness." FY05, evaluate effectiveness of current and state-of-the-art programs for weight management in the military environment.	0	0	2000	2000

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601105A - Force Health Protection

PROJECT
D52

Accomplishments/Planned Program (continued)

FY04, demonstrate likely mechanisms of interaction of chemicals used for medical prophylaxis (treatment/disease prevention) in deployments (e.g., DEET, permethrin, pyridostigmine bromide) on the basis of key enzyme systems responsible for metabolism of toxic chemicals. Additionally, evaluate the association between squalene antibodies and chronic multi-symptom illnesses based on pre- and post-deployment studies. FY05, explore the feasibility of improved rapid assessments of local infectious threats based on medical entomology (insect) studies. Determine the effects of stress on blood-brain barrier and the ability of drugs to unexpectedly reach the brain.

FY 2002	FY 2003	FY 2004	FY 2005
0	0	3347	3296
0	0	9847	9796

Totals

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget	0	0	0	0
Current Budget (FY 2004/2005 PB)	0	0	9847	9796
Total Adjustments	0	0	9847	9796
Congressional program reductions				
Congressional rescissions				
Congressional increases				
Reprogrammings				
SBIR/STTR Transfer				
Adjustments to Budget Years			9847	9796

Significant Changes:

FY04 - PE was devolved from OSD to Army; funds Gulf War Illnesses research.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601114A - Defense Experimental Program to Stimulate Competit					PROJECT D54			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
D54 DEFENSE EXPERIMENTAL PROGRAM COMPETITIVE RESEARCH	0	0	9730	9614	9766	9951	9981	10185	

A. Mission Description and Budget Item Justification: In FY03 and prior years, this effort was centrally funded by the Office of the Secretary of Defense (OSD) in PE 0601114D8Z and funded the Defense Experimental Program to Stimulate Competitive Research (DEPSCoR). The Army has been designated by the Office of the Secretary of Defense as the lead service for planning and execution of this program. The DEPSCoR is a legislated program that helps build national infrastructure for research and education by funding research activities in science and engineering fields important to national defense. Participation in this program is limited to states that meet eligibility criteria as set forth in the authorizing language. The DEPSCoR is designed to expand research opportunities in states that have traditionally received the least funding in federal support for university research. The program is intended to improve the capabilities of institutions of higher education (IHE) to develop, plan and execute science and engineering research that is competitive under the peer-review system. IHEs in eligible states are invited, through their NSF State EPSCoR Committee, to compete for research/infrastructure awards in areas identified in broad agency announcements regularly published by the Army Research Laboratory (Army Research Office) on behalf of the Army, Navy (Office of Naval Research), and Air Force (Air Force Research Laboratory, and Air Force Office of Scientific Research). The cited work is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and supports the Objective transition path of the Transformation Campaign Plan. There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601114A - Defense Experimental Program to Stimulate Competit	PROJECT D54
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
In FY04: This is a congressionally mandated program that will continue to be conducted in a manner consistent with the goals established in the authorizing legislation and at a level of performance directly proportional to the funding that is annually adjusted by Congress. Research/infrastructure grants are awarded to academic institutions in 18 States, including Puerto Rico, to perform research in science and engineering fields important to national defense. Research proposals from eligible states will be competitively selected for funding by the Army Research Laboratory (Army Research Office), Navy (Office of Naval Research) and Air Force (Air Force Research Laboratory and Air Force Office of Scientific Research). DEPSCoR awards average \$315K over the three year grant period. In FY05, continue evaluation of awards made with prior year funds and make additional competitive new awards.	0	0	9730	9614
Totals	0	0	9730	9614

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget	0	0	0	0
Current Budget (FY 2004/2005 PB)	0	0	9730	9614
Total Adjustments	0	0	9730	9614
Congressional program reductions				
Congressional rescissions				
Congressional increases				
Reprogrammings				
SBIR/STTR Transfer				
Adjustments to Budget Years			9730	9614

Significant Changes:
 FY04 - PE devolved from OSD to Army as Lead Service for planning and executing this congressionally mandated program that seeks to expand research opportunities in states that have traditionally received the least Federal funding for university research.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 1 - Basic research	PE NUMBER AND TITLE 0601228A - Historically Black Colleges and Universities/Minor					PROJECT D53			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
D53 HBCU/MI	0	0	14083	14230	14483	14735	15357	15670	

A. Mission Description and Budget Item Justification: Prior to FY04, this effort was centrally funded by the Office of Secretary of Defense (OSD) in PE 0602228D8Z. This program funds research at Historically Black Colleges and Universities and Minority Institutions (HBCU/MI), Hispanic Serving Institutions (HSI), and Tribal Colleges (TC). This program provides infrastructure support in fields of science, mathematics and engineering that are important to national defense and encourages participation of small minority schools and minority research universities. This competitive program provides support through grants or contracts for research, collaborative research, education assistance, instrumentation purchases, and technical assistance at minority institutions nationwide in the following areas:

- Research: The research grants are designed to further knowledge in the basic scientific disciplines through theoretical and empirical activities. Collaborative research allows university professors to work directly with military laboratories or other universities. Collaborators may include other educational institutions (not necessarily HBCU/MIs, HSIs or TCs), a DoD laboratory or Research, Development, and Engineering Center (RDEC), a DoD University Affiliated Research Center (UARC), and/or industry or small business partner.
- Education: Education assistance funds are used by the selected minority institutions to strengthen their academic programs in science, mathematics, and engineering thereby increasing the number of under-represented minorities obtaining undergraduate and graduate degrees in these fields. These grants provide equipment, scholarships, cooperative work/study opportunities, visiting faculty programs, summer programs, and a variety of other enhancements designed to support students and to encourage them to pursue careers in science, mathematics, and engineering.
- Infrastructure: Funds for instrumentation allow minority institutions to enhance their capability to perform research of interest to the Department. This program allows the university to purchase basic laboratory equipment for education program enhancements and/or highly sophisticated research equipment, such as lasers and spectrometers.
- Technical assistance: These funds are used to design programs to enhance the ability of minority institutions to successfully compete for future Army funding. The objective is to assist the HBCU/MI, HSI and TC communities in areas including proposal writing and administration of grants and contracts.

The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and supports the Objective transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601228A - Historically Black Colleges and Universities/Minor

PROJECT
D53

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- In FY04, continue evaluations of awards made with prior year funds. This program will make competitive awards to HBCU/MI institutions, Hispanic Serving Institutions (HSI), and Tribal Colleges (TC). These awards will be a combination of new awards and continuations of some grants and other efforts awarded in the previous year depending on technical progress. In FY05, continue evaluation of awards made with prior year funds and make additional competitive new awards to HBCU/MIs, HSIs and TCs.	0	0	14083	14230
Totals	0	0	14083	14230

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget	0	0	0	0
Current Budget (FY 2004/2005 PB)	0	0	14083	14230
Total Adjustments	0	0	14083	14230
Congressional program reductions				
Congressional rescissions				
Congressional increases				
Reprogrammings				
SBIR/STTR Transfer				
Adjustments to Budget Years			14083	14230

Significant Changes:

FY04 - PE devolved from OSD to Army; funds research at Historically Black Colleges and Universities and Minority Institutions (HBCU/MI), Hispanic Serving Institutions (HSI), and Tribal Colleges (TC).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	20206	33621	15186	14881	15148	15918	16044	16421
H7B ADVANCED MATERIALS PROCESSING	6955	7434	0	0	0	0	0	0
H7D ELECTRONICS COMPONENTS RELIABILITY	0	2382	0	0	0	0	0	0
H7E MATERIALS JOINING FOR ARMY WEAPONS	0	2859	0	0	0	0	0	0
H7F PRECISION MAGNETORHEOLOGICAL FLUIDS	0	3241	0	0	0	0	0	0
H84 MATERIALS	13251	17705	15186	14881	15148	15918	16044	16421

A. Mission Description and Budget Item Justification: This program element (PE) provides materials technology for armor and armaments to enable US dominance in future conflicts across a full spectrum of threats in a global context, by increasing the survivability and lethality of Future Combat System (FCS) and Objective Force systems. Project H84 is directed toward devising materials technology that will make our heavy forces lighter and more deployable, and our light forces more lethal and survivable. It provides the technology base, including a new thrust in nanomaterials, required for solving materials-related problems in individual soldier support equipment, armor, armaments, aircraft, ground and combat vehicles and combat support. 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), and PE 0603008 (Command, Control, Communications Advanced Technology). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds (DERF) have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	20617	18659	14215	15602
Current Budget (FY 2004/2005 PB)	20206	33621	15186	14881
Total Adjustments	-411	14962	971	-721
Congressional program reductions				
Congressional rescissions		-1903		
Congressional increases		17700		
Reprogrammings	-147	-194		
SBIR/STTR Transfer	-264	-641		
Adjustments to Budget Years			971	-721

Change Summary Explanation:

Significant Changes:

FY04: Funds increased to support nanomaterials research at the Institute for Soldier Nanotechnologies University Affiliated Research Center (UARC).

FY03 Congressional Adds:

Precision magnetorheological fluids to polish large optics, Project H7F (\$3400); Advanced Coatings Research to Extend the Service Life of Vehicles and Equipment, Project H84 (\$1000); Advanced materials processing, Project H7B (\$2800); Electronic components reliability, Project H7D (\$2500); FCS Composite Research, Project H7B (\$1500); Future affordable Multi-Utility Materials for FCS, Project H7B (\$1400); Low Cost Enabling Technologies, Project H7B (\$2100); Materials Joining for Army Weapons (\$3000)

Projects with no R-2A:

(\$3348) Precision magnetoheological fluids to polish large optics, Project H7F: The objective of this one-year Congressional Add is to develop new approaches to affordably polishing large-scale optics three meters or greater in diameter. No additional funding is required to complete this project.

(\$2761) Advanced Materials Processing, Project H7B: This one-year Congressional add focuses on applied research in advanced material characterization and processing technologies for composite and metallic materials. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)**February 2003****BUDGET ACTIVITY
2 - Applied Research****PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY**

(\$2465) Electronic Components Reliability, Project H7D: The objective of this one-year Congressional Add is to optimize munitions design by simulating the physics of electronic component reliability under realistic loading conditions found in vehicles and munitions. No additional funding is required to complete this project.

(\$1480) FCS Composite Research, Project H7B: This one-year congressional add focuses on advanced resins and fibers, thick-section mechanics, damage tolerance, processing sciences, validated design models, and predictive models for the optimal application of composite materials for FCS requirements. No additional funding is required to complete this project.

(\$1381) Future Affordable Multi-Utility Materials for FCS, Project H7B: This one-year congressional add focuses on maturing advanced lightweight materials processing technologies that will enable a cost effective, survivable, durable, and deployable FCS force. No additional funding is required to complete this project.

(\$2071) Low Cost Enabling Technologies, Project H7B: The objective of this one-year Congressional Add is to mature affordable processing of advanced multi-functional materials for wide range of Army applications. No additional funding required to complete this project.

(\$2958) Materials for Joining Army Weapons, Project H7E: The objective of this one-year Congressional Add is to mature affordable joining technologies (friction stir welding, laser hybrid welding) to provide capability to join complex shapes, dissimilar materials, and out of tolerance parts (wide gaps) to ensure full range of reliable and sustainable Objective Force platforms. No additional funding required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602105A - MATERIALS TECHNOLOGY						PROJECT H84	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H84 MATERIALS	13251	17705	15186	14881	15148	15918	16044	16421

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), Objective Force Warrior (OFW) and other Objective Force platforms. In order to meet the challenge of the Army Vision, new systems must be significantly lighter, more deployable, and more sustainable. A barrier to this challenge is the requirement for 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, 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. The work is conducted at the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD and Hampton, VA 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 (CECOM), Ft. Monmouth, NJ. This project also funds a collaborative research effort in nanomaterials technology between the ARL and the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology, MA. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY

PROJECT
H84

Accomplishments/Planned Program

- Optimize lightweight armor materials/structures, processing methodology, and modeling and simulation tools to enable development of lightweight frontal and structural armors that will revolutionize FCS and Objective Force platform survivability. In FY02, validated penetration and structural simulations and integrated emerging materials technology (lightweight metals, ceramics, ceramic laminates, composites, and energetic materials) with novel defeat mechanisms; validated improved, cost-effective manufacturing process for multifunctional composite structures and transitioned technology to FCS. In FY03, optimize lightweight armor materials, structures, and modeling and simulation tools for transition to FCS vehicle designers. In FY04, provide and evaluate improved materials and processes to include functionally graded materials (FGMs) and transparent ceramics that increase performance of FCS armor systems and create computational methodologies for design of blast and impact-resistant multifunctional (e.g., power, communications, propulsion, sensory) composite structures for FCS enhancement. In FY05, prove low cost processing of enhanced structural armor, metallics, and ceramics to enable advanced armor technology development and validate computational methodologies for design of blast and impact-resistant multifunctional (e.g., power, communications, propulsion, sensory) composite structures critical for full-spectrum survivability of FCS/Objective Force platforms.

FY 2002	FY 2003	FY 2004	FY 2005
3812	3129	3104	3147

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY

PROJECT
H84

Accomplishments/Planned Program (continued)

- Optimize lightweight armor materials and defeat mechanisms against emerging threats and provide advanced processing techniques to enable affordable design of future multifunctional ballistic protective systems for the OFW. In FY02, investigated novel lightweight armor materials (boron carbide, silicon carbide) and processing techniques, refined physics-based models, and showed improved performance of lightweight ballistic protection for the future warrior; and designed and synthesized novel nano-structured materials (dendrimers, nanocomposites, self-assembled polymers) and multi-functional coatings (water dispersible, chemical agent resistant, nanoreactor fabric). In FY03, provide novel lightweight materials and physics-based design tools to development community for integration into OFW protective systems; and employ advanced models and processing techniques to optimize performance of promising nano-structured materials and multi-functional coatings to provide improved protection and sustainability for the Objective Force. In FY04, optimize lightweight armor materials and defeat mechanisms against emerging threats and provide prototype armors that incorporate advanced processing techniques to enable affordable design of future multifunctional ballistic protective systems for the OFW. In FY05, validate computational models and investigate armor materials and processing techniques that will enable the fabrication of a uniform with integrated warrior electronic devices and multi-functional ballistic protection.

FY 2002	FY 2003	FY 2004	FY 2005
3735	3128	1668	2049

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY

PROJECT
H84

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- Investigate ceramic, composite and other advanced materials to enable FCS and Objective Force lethality. Design, validate, and optimize advanced and electroceramic materials and processing techniques for smaller more lethal penetrators and affordable, lightweight high performance armaments for revolutionary Objective Force lethality. In FY02, devised improved models, employed novel characterization techniques, and proved sheathed penetrator processing technologies that will enable the design and synthesis of improved penetrator/warhead materials for future munitions; showed the utility (e.g., strength, erosion resistance, thermal properties, manufacturability) of several commercially available ceramics for application to gun barrels; and optimized mechanical characterization techniques and devised non-linear analysis capability for continuous fiber metal matrix and completed design for an FCS cargo shell. In FY03, synthesize candidate penetrator/warhead alloys, evaluate ballistic performance against threat armors, and initiate transition of promising concepts to ammunition designers; characterize candidate ceramics in non-ballistic environment and design gun barrel concept/sheathing technologies; and design, produce, and characterize prototype metal matrix composite projectile shell and transition design tools and prototype to ammunition designers for application to FCS to enable lightweight, lethal FCS/Objective Force munitions. In FY04, characterize failure mechanisms in emerging anti-armor materials and investigate effects of processing variables and constituents for improved design of penetrators/warheads; and prove 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 Objective Force. In FY05, transition improved anti-armor materials and ceramic gun barrel technology to ARDEC/AMRDEC.</p>	3221	5154	5028	4159
<p>Design and optimize electro-ceramic materials and processing techniques for integration by CECOM into advanced antennas that will enable affordable, reliable Command, Control, Communications (C3) Information for FCS and Objective Force platforms. In FY02, evaluated electro-ceramic materials (functionally doped BSTO thin films and bulk ceramic composites) properties for discrete and integrated microwave applications including fire control radar, smart munitions, and point-to-point communications. In FY03, design and fabricate new electro-ceramic materials. In FY04, validate affordable processing methods to improve performance and integration into communication systems for FCS. In FY05, transition technology to CECOM.</p>	500	480	450	446

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY

PROJECT
H84

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- 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 Objective Force Warrior survivability. Research conducted by ARL in collaboration with ISN Industry Partners. In FY02, devised unique high strain rate nanomaterials characterization capability and proved novel nanomaterials technologies for reversible adhesive bonding, stimuli-responsive actuation and biological agent detection techniques. In FY03, exploit nanocomposite material breakthroughs to design and fabricate ultra-lightweight structural and ballistic protection concepts, and scale-up processing and fabrication of novel lightweight energy absorbing nanomaterials for experimental evaluation. In FY04, design and develop scalable processing/synthesis methods and demonstrate improved physics-based materials property models. In FY05, validate multiple protective materials designs that incorporate at least three functions (e.g., ballistic, blast and fire/flame protection) with reduced weight within single integrated system and exploit selected processing methodology to fabricate prototype nanomaterials-based, functionally integrated specimens for testing and evaluation.	1983	4847	4936	5080
Advanced Coatings Research to Extend the Service Life of Vehicles and equipment: This one year congressional add focuses on providing novel coatings to improve the reliability/durability, and significantly reduce life-cycle costs, of Army Materiel. No additional funding is required to complete this project.	0	967	0	0
Totals	13251	17705	15186	14881

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602120A - Sensors and Electronic Survivability

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	31635	21820	22765	25510	33882	37172	37928	31864
140 HI-POWER MICROWAVE TEC	2691	2766	2898	2954	3656	3721	3773	3864
142 PASSIVE MMW CAMERA	2015	0	0	0	0	0	0	0
H15 GROUND COMBAT ID TECH	7492	3477	4836	4970	6064	6142	6247	8304
H16 S3I TECHNOLOGY	17039	15577	15031	17586	24162	27309	27908	19696
SA1 ADVANCED SENSORS AND OBSCURANTS	2398	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this program is to enhance the capabilities of the Future Combat Systems (FCS) and the Objective Force by: 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. Critical technologies to be addressed to increase the combat effectiveness of tactical Army forces include: high power, solid-state/vacuum, power/RF component technology; combat identification technology; and sensors, signatures, signal and information processing (S3I) technology. 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602120A - Sensors and Electronic Survivability

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	31934	24305	24624	25834
Current Budget (FY 2004/2005 PB)	31635	21820	22765	25510
Total Adjustments	-299	-2485	-1859	-324
Congressional program reductions				
Congressional rescissions		-2174		
Congressional increases				
Reprogrammings	148	-125		
SBIR/STTR Transfer	-447	-186		
Adjustments to Budget Years			-1859	-324

Change Summary Explanation:

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A - Sensors and Electronic Survivability	PROJECT 140						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
140 HI-POWER MICROWAVE TEC	2691	2766	2898	2954	3656	3721	3773	3864

A. Mission Description and Budget Item Justification: This project focuses on efforts to significantly improve the survivability, lethality, deployability, and sustainability of Future Combat Systems (FCS) and the Army's Objective Force by devising high-power electronic components and technologies for compact, lightweight power and energy storage, conversion and conditioning. Current technical barriers result in excessive size and weight requirements for these components and systems. Matching of potential FCS radio frequency (RF)/microwave directed energy (RF-DE) and high energy laser (HEL) weapons and other electric power loads such as electromagnetic gun, electromagnetic (EM) active protection armor and electric drive to the FCS electric power sources will be improved with the advances in this project. This program is coordinated and, when appropriate, leveraged with directed energy (both RF and laser) and power programs in the Air Force, Navy, Defense Special Weapons Agency, National Labs, university consortia and relevant industry and foreign partners. This work is done in coordination with the Tank and Automotive Research, Development and Engineering Center (TARDEC), the Armaments Research, Development and Engineering Center, and the Communications and Electronics Command Research, Development and Engineering Center (CERDEC). The emphasis of this project is being focused to more effectively support the Army Transformation, by concentrating on the critical path technology of power components common to all Directed Energy Weapons (DEW) and hybrid electric propulsion systems. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602120A - Sensors and Electronic Survivability

PROJECT
140

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Perform technology -base R&D in power converter design and high-temperature devices to achieve high-power and high-temperature operation of power converters with enhanced performance while significantly reducing size and weight to meet the stringent weight/volume requirements of the Future Combat Systems and ultimately the Objective Force. In FY02: characterized silicon-based 100 kW matrix converter in relevant environment for motor control. Evaluated 4 kW silicon carbide (SiC) high-temperature bi-directional switch module. In FY03, evaluate a brassboard 10 kW SiC module and 100 kW Si matrix converter. In FY04, install and evaluate SiC power devices in a high temperature 10kW matrix converter. In FY05, fabricate, install and evaluate SiC power devices in the world's first high-temperature matrix converter at 100 kW power level in a relevant environment controlling an electric drive traction motor such as those needed for FCS applications. This is in support of work done in TARDEC on power generation, conditioning and control.</p>	1300	1328	1442	1900
<p>- Design of RF-Agile Target Effect System (ATES) breadboard. Investigate and mature components and sub-systems such as antennas and microwave sources to support the non-lethal and directed energy program. Conduct susceptibility experiments on targets of interest to the ATES STO program. In FY02, completed first round of laser/RF synergy tests on items selected by ARDEC. In FY03, expanded 2nd generation synergy experiments will be conducted on ARDEC-selected targets and microwave (MW) components will be investigated. In FY04, MW component designs will be matured for inclusion in system designs. In FY05, complete design for ATES breadboard system with state-of-the-art components suitable for integration onto hybrid-electric platforms.</p>	1015	1041	1057	558

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Investigate electronic warfare (EW) survivability, lethality, EW tools technology, and methodology research. In FY 02, completed analysis of unmanned aerial vehicle (UAV) countermeasure runs for anti-radiation missile (ARM) survivability model development and finished statistical analysis of secondary modulation signal used to develop electric countermeasures. In FY03, complete theoretical design analysis of a narrow band filter (Faraday Anomalous Dispersion Optical Filter (FADOF)) that provides a multi-spectral approach in identification of extremely low signature missile propellants. Conduct theoretical studies and develop algorithms for atmospheric propagation of this phenomenology. These technology efforts support the Full Spectrum Active Protection (FSAP) effort for TACOM in support of the Future Combat Systems (FCS). In FY04, investigate integration of the FADOF onto FCS platforms, design concepts for fiber optic bundles, and develop Electronic Warfare/Electro Optic (EW/EO) models/simulations of atmospheric/background clutter processes impacting hit avoidance mechanisms. In FY05, investigate a methodology, tool set, generic radar sensor, and EW models for EW survivability analysis of missile defense and sensor systems.	376	397	399	496
Totals	2691	2766	2898	2954

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A - Sensors and Electronic Survivability						PROJECT H15	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H15 GROUND COMBAT ID TECH	7492	3477	4836	4970	6064	6142	6247	8304

A. Mission Description and Budget Item Justification: US and Allied Forces lack a comprehensive combat identification (CID) system to prevent fratricide. The objective of this project, the Coalition Combat Identification ACTD, is to mature and demonstrate emergent CID systems for joint, allied and coalition air-to-ground and ground-to-ground mounted, dismounted, forward observer and forward air controller mission for the Objective Force. This program provides the technologies necessary for US, UK, French, German, Canadian and Australian Coalition Combat Identification Advanced Concept Technology Demonstrations (ACTD). The program provides maturation of the enabling technologies to demonstrate common identification (ID) standard agreements (STANAGs), reduce weight and cost, and evaluate radio frequency (RF) tags, such as those under development by DARPA as a CID enabler. This program will set the baseline for the Objective 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 program 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. The system must operate successfully in all weather environments and must not be impacted by smoke, fog, dirt and other obscurants. The Objective 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. Future CID will operate with the Objective Warrior System providing a seamless boundary with vehicle CID. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) were provided to the program/project.

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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- In FY02, completed radio based study to investigate the possibility of migrating the Radio Based Combat Identification (RBCI) from the Ground System Improvement Program (SIP+) SINCGARS to the Advanced SIP (ASIP+) SINCGARS radio and the potential for use on exportable ASIP radios for multinational CID. In FY03, coordinate allied participation in ACTD (GE, UK, FR, CA, AUS). Share technical approaches to develop hardware and implement the Battlefield Target ID (BTID) and Dismounted Soldier CID (DSCID) STANAGs. Develop RBCID using the ASIP SINCGARS. In FY04, develop a smaller, lighter, more efficient and less costly version of the Battlefield Combat Identification System Millimeter Wave system with a NATO STANAG approved waveform. Coordinate development of a NATO standard for DSCID for a US/NATO common system to increase protection to the dismounted soldier. Plan/Conduct a CID Military Operation in an Urban Terrain exercise. In FY05, develop modeling and simulation capability to conduct international virtual operational exercise to evaluate technologies and test or establish new tactics, techniques and procedures. Conduct technical, operational, and simulated test and evaluation.	7492	3477	3878	4056
- In FY05, evaluate the use of RF Tags in conjunction with a SAR/MTI radar to provide passive CID. Develop ground integrated target identification system for ground-to-ground CID for the Objective Force. This will integrate CID data from cooperative and non-cooperative target identifiers (FLIR, EPLRS, RF Tags, Radar, tactical internet, etc.) and situational awareness sensors to display CID results through the sight. Mitigates engagement latency and provides beyond line-of-sight capability.	0	0	958	914
Totals	7492	3477	4836	4970

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A - Sensors and Electronic Survivability						PROJECT H16	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H16 S3I TECHNOLOGY	17039	15577	15031	17586	24162	27309	27908	19696

A. Mission Description and Budget Item Justification: This project is focused on advanced sensor, signal processing and information technologies to provide the Future Combat Systems (FCS), Objective Force Warrior (OFW) and other emerging thrusts with decisive new capabilities to locate, identify, and engage battlefield targets. The ultimate 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, movement of sensors on military vehicles, etc. Cost reduction is a key focus. 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). Significant areas of research include: 1) 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. Research is conducted in fusion of diverse sensors such as acoustic, seismic, magnetic, radar, IR, visible imagers, etc. Technical barriers are: diverse, low-power sensors, autonomous networks, and sensor fusion. Algorithms and concepts transitioning to Communications and Electronics Command (CECOM) Disposable Sensors Program. 2) Low cost acoustic, seismic and magnetic sensors that can passively detect and track battlefield targets such as tanks, helicopters, etc. and locate gun fire. 3) Sensor technologies for the detection and tracking of humans, especially in urban terrain. Technical barriers: effective fusion of many diverse sensor types and innovation of high reliability, low cost approaches. 4) High performance multi-function radio frequency (RF) systems which allow target acquisition, combat identification, active protection, surveillance, and communications systems consolidated into a single system, reducing system cost and size. Technical barrier: maintaining performance of each function in the combined system. 5) 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. Technical barriers include real-time signal processing and false alarm rate. 6) Aided/automatic target recognition (ATR) to allow sensors to autonomously locate and identify targets. Algorithms will minimize the workload on the soldier in combat to find and identify targets using laser radar (LADAR), multi-band infrared cameras, and hyperspectral imagers. 7) 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. Sensor processing, analysis, and displays will provide soldiers with clearer, higher resolution images from their targeting systems. 8) Advanced battlefield sensor and information processing to conduct a dynamic and real time situation assessment to present a common picture of the battlespace. Technical barriers: fusion of data from dissimilar sensors, coherent display of complex information, and human factors. 9) Advanced information processing methods to provide automatic information technologies which utilize widely dispersed sensor and legacy information sources. Technical barrier: development of autonomous networks. This work supports the following Army Programs: FCS, OFW, Networked Sensors for the Objective Force (NSfOF)ATD, Multi-Function Starting Sensors Suite (MFS3), Warrior Extended Battlespace Sensors (WEBS), Anti-Personnel Landmine Alternatives (APLA), 3rd Generation forward-looking infrared (FLIR), Full Spectrum Active Protection, and Quicklook. Work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance.

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The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds were provided to this program.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- Mature underpinning technologies for low-cost unattended ground sensors (UGS) for homeland defense, counter-terrorism, FCS and OFW. Implement and mature advanced passive acoustic/seismic algorithms to detect, track and ID targets for UGS. In FY02, completed and evaluated 2nd generation processor for UGS; implemented 3-axis seismic sensors for direction finding and fused output with acoustic sensors and implemented algorithm on testbed; and studied key underpinning technology needs for sensors for position / orientation. In FY03, conduct field experimentation and evaluation of new passive sensors technologies and capabilities for multi-target detection, classification and tracking; characterize robust beam forming algorithm for multi-target vehicle tracking; and conduct field exercises for experimentation, technology characterization, and capability determination. In FY04 implement acoustic / seismic sensor fusion algorithm for multi-target tracking and ID in support of Networked Sensors for the Objective Force ATD; and design low-cost magnetic sensor for CECOM Disposable Sensors Program. In FY05, provide mature sensor nodes and algorithms along with RF, magnetic, electric field, and acoustic technology required for providing baseline personnel detection capability to CECOM for use in Networked Sensors for the Objective Force ATD and transition to CECOM Disposable Sensors Program.</p>	4856	5397	5188	5599

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Implement new target recognition and image understanding techniques to detect and ID targets in clutter for implementation on manned and unmanned systems. Mature low cost LADAR and target recognition techniques for 3rd Generation FLIR in support of CECOM program for FCS sensors. In FY02, matured and transitioned a technique for recognizing moving targets to the Long Range Advanced Scout Sensor System (LRAS3) CECOM/CRDEC program; conducted LADAR data collection experiments, analysis and evaluation of targets under camouflage and targets for robotic perception obstacle avoidance applications; and implemented ATR algorithm for dual color FLIR systems. In FY03, investigate FLIR and multi/hyperspectral imagery for target recognition applications; evaluate improvement in performance of dual color FLIR algorithm over single band FLIR algorithms; and conduct field experiments using line array LADAR. In FY04, expand moving target techniques to include sensor effects and multiple sensors. In FY05, implement new target recognition algorithms in multi-sensor experiments, mature eye-safe staring array LADAR and conduct extensive field experiments.	1787	1851	2054	2252
- 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 SAR to detect buried mines. In FY02, completed major field experiment to collect UWB radar data on various types of obstacles effecting mobility of robotic vehicles. In FY03, demonstrate ability of UWB radar to detect obstacles. In FY04 develop radar imaging techniques to assess the value of 3D resolution for detecting negative obstacles. In FY05, develop and evaluate physics-based mine detection algorithm.	1123	1219	866	968
- 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. Building on results from other work units, use enhanced models and measurements on tactical vehicles and clutter to produce improved target detection, tracking and classification algorithms for FCS tactical radars. In FY02, compared EM model outputs to turntable measurements on a tactical vehicle through MMW frequencies and identified technical issues associated with signature modeling of ground vehicles. In FY03, develop metrics to assess the signature prediction performance of x-patch; characterize issues such as the vehicle CAD accuracy, geometry complexity and material composition. In FY04, using facet files generated from CAD, model an FCS-like vehicle at X-band and Ka-band and assess accuracy of prediction. In FY05, evaluate hybrid approaches to model complex targets. Compare hybrid approaches to x-patch.	776	849	1944	2111

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Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Multifunction RF and optical interconnects for use on small ground and air vehicles and Objective Force Warrior (OFW). Mature understanding of phenomenology for an integrated RF sensor that performs radio, radar, and control functions to allow communications, combat-ID, target acquisition and track, active protection, and munition command guidance for use on small ground and air vehicles. Mature optical data links and optical data processing architectures to accept massive raw data streams from multiple FCS sensors and efficiently produce real-time battlespace information for commanders and the OFW. Mature models and evaluate networked sensor concepts in support of netted fires to allow dynamic updating of weapons in-flight. In FY02, collected and analyzed radar signatures of vehicles in clutter and successfully tracked, in range and velocity high-speed kinetic energy penetrators in flight, to support full spectrum active protection (FSAP); delivered real-time optical data link to Aviation and Missile Research, Development and Engineering Center (AMRDEC) for demonstration in missile testbed; and produced a simulation of distributed sensor concept to provide targeting information for beyond line of sight weapons. In FY03, characterize RF multi-function and communication waveforms in a testbed and generate location errors for various sensor types and mixes. In FY04 develop refined multi-sensor tracking techniques, assess monopulse tracking errors of KE penetrators, and develop beam scheduling techniques and complementary detection algorithms for a multi-function tactical radar. In FY05, determine the utility of polarimetric MMW imaging for aircraft navigation, landing, and obstacle avoidance in limited visibility conditions. Establish improvement in munition lethality available through dynamic updating. Provide and characterize a breadboard optical datalink subsystem with increased data rates beyond 1 Tb/s.</p>	4189	4042	2839	3228
<p>- Improve 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 FY02, transitioned to CECOM a diverse suite of software components that significantly improved information access and operator focus of attention so that important battlefield events are rapidly perceived and understood. In FY03, provide agent architecture to enable information fusion from diverse databases. In FY04, develop 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 to CECOM Network Centric Warfare C2 Program (follow on to CECOM Agile Commander Advanced Technology Demonstration).</p>	2547	2219	2140	2528

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
-S3I Technology: The objective of this one-year congressional add was to enhance the S3I core technology. No additional funding is required.	1761	0	0	0
Exploit breakthroughs in biotechnology basic research transitioning from the Army Biotechnology Research Center, a University Affiliated Research Center, to enable revolutionary Objective Force capabilities in sensors, electronics and photonics. In FY05 mature emerging opportunities in areas such as biomolecular based detector arrays for new sensors, biocomputing leading to advanced computing capability, biological photovoltaic power sources for reduced logistics demand, and biomimetics and biomimetics processing leading to new electro-optic materials, chemical detectors and structural multifunctional smart materials. Applied reseach will be conducted by ARL in collaboration with Center industry partners.	0	0	0	900
Totals	17039	15577	15031	17586

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602211A - AVIATION TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	41295	39693	39459	41886	43272	41166	45463	39425
47A AERON & ACFT WPNS TECH	37813	35999	35689	38111	39209	37035	41294	35148
47B VEH PROP & STRUCT TECH	3482	3694	3770	3775	4063	4131	4169	4277

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 Objective Force and Joint Vision 2020. Based on the Army transformation, this PE is focused to investigate technologies applicable to unmanned systems and selected opportunities for manned systems. Unmanned RWVs bring unprecedented agility, maneuverability, and lethality to the Objective Force, while providing reduced signature and logistics. Emphasis is on developing rotary wing platform technologies to support unmanned combat, reconnaissance, and communications relay capabilities. Technologies that enable autonomous flight, higher aerodynamic loads, lower detectability and increased maneuverability will be emphasized. These technologies also will be assessed for their ability to support the long-term sustainability and reduced logistics required of Objective Force airframes. This PE supports Phase I and II of the Unmanned Combat Armed Rotorcraft (UCAR) and unmanned technologies for the A-160 Hummingbird, the Organic Air Vehicle (OAV), the Micro Air Vehicle (MAV) and the Unmanned Cargo Lifter. This PE also supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry and academia, and adds a major focus to develop organic air vehicles designs and other unmanned rotorcraft technologies. Efforts under this PE transition to projects supported by PE 0603003A (Aviation - Advanced Technology). Upgrade activities of DoD systems such as the RAH-66 Comanche, AH-64 Apache, UH-60 Black Hawk, Navy SH-60 Seahawk and USMC AH-1 Cobra are included in this PE. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance, for which the Army is the lead service for the maturation of rotorcraft science and technology. The program element does not duplicate with any effort within the Military Departments. 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 Ames Research Center, Moffett Field, CA; Glenn Research Center, Cleveland, OH; and Langley Research Center, Hampton, VA. This PE supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this program.

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<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	43859	43692	34857	34792
Current Budget (FY 2004/2005 PB)	41295	39693	39459	41886
Total Adjustments	-2564	-3999	4602	7094
Congressional program reductions				
Congressional rescissions		-3262		
Congressional increases				
Reprogrammings	-1952	-227		
SBIR/STTR Transfer	-612	-510		
Adjustments to Budget Years			4602	7094

Change Summary Explanation: Funding - FY 2004/2005: Funds realigned to this PE from PE 0603003A Aviation Advanced Technology to conduct applied research for increasing levels of autonomy for vertical takeoff and landing (VTOL) unmanned aerial vehicles (UA V).

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602211A - AVIATION TECHNOLOGY						PROJECT 47A	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
47A AERON & ACFT WPNS TECH	37813	35999	35689	38111	39209	37035	41294	35148

A. Mission Description and Budget Item Justification: The Aeronautical and Aircraft Weapons Technology project investigates RWV technologies for unmanned and manned Army / DoD rotorcraft to increase strategic and tactical mobility / deployability; improve combat effectiveness; increase aircraft survivability; and improve combat sustainability. This project supports the Objective Force and Joint Vision 2020 by providing technology to improve capabilities in Dominant Maneuver, Precision Engagement and Focused Logistics. Areas of research are focused on technology application to UAV systems, manned/unmanned teaming, and selected opportunities for manned systems. These system technologies will provide enhanced rotor efficiencies, improved survivability, increased structure and airframe capability, improved engine performance, improved sustainability, and reduced cost of unmanned and manned aerial vehicles. This project will begin research for the Unmanned Combat Armed Rotorcraft (UCAR), a lethal, survivable Vertical Takeoff and Landing (VTOL) UAV capable of autonomous operations. UCAR is a joint program with the Defense Advanced Research Projects Agency (DARPA) and is planned to transition to Program Executive Officer Aviation at the completion of its 6.3 funded phases. UCAR will be capable of performing mobile strike operations; reconnaissance; target acquisition and identification; suppression of enemy air defense (SEAD), and teamed with the RAH-66 Comanche, will bring unprecedented lethality to the Army's Objective Force. This project supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry and academia, and adds a major focus to develop organic air vehicles 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 objective force systems. These engine component technologies address engine needs for future UAVs, such as the UCAR and A-160 Hummingbird, with up to a 50% endurance increase and 30% payload increase over current available turbine engines. These component technologies also will enable engine demonstrations for manned systems, providing a 33% payload improvement and 28% range increase for the RAH-66 Comanche; 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 the Army's Future Utility Rotorcraft. Advanced active controls, aerodynamics, handling qualities, acoustic signature attenuation and smart materials (materials that respond to specific stimuli) technologies will provide rotors and flight controls with increased payload, range, maneuverability, agility and survivability. Unmanned/manned system interface, autonomous collaborative flight control, flight simulation, weapons and sensor integration, and pilot-vehicle interface technologies are focused on research of advanced mission equipment packages that will provide full spectrum engagement, precision and selectable lethality, suitable for the target and engagement scenario. This project also supports work done by NASA and work done under the auspices of the NRTC. Work in this project is performed by the Aeroflightdynamics Directorate of the Aviation and Missile Research, Development and Engineering Center (AMRDEC), located at the NASA Ames Research Center, Moffett Field, CA and the Aviation Applied Technology Directorate located at Fort Eustis, VA. Technologies researched within this project will transition to advanced development technology demonstration programs with application to future, as well as current, Army / DoD rotorcraft systems. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

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<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>Unmanned Combat Armed Rotorcraft (UCAR)- In FY02 executed Memorandum of Agreement with DARPA to initiate the UCAR program. Completed Source Selection and began program with Phase I Concept Development and System Trades to conduct requirements analyses, design trade studies, and risk reduction. Industry teams conducted design trades that considered alternative vehicle/mission equipment configurations and system of systems architecture. Teams documented/evaluated UCAR configuration and architecture design alternatives with respect to system performance, mission effectiveness, life cycle cost, and risk. Teams prepared Risk Management and Mitigation Plan and conducted Systems Requirements Review. In FY03, complete Phase I and initiate Phase II Preliminary Design with one or more industry teams. Industry teams will conduct Preliminary Design of UCAR System to include vehicle systems/subsystems, survivability features, weapons/sensors integration, and system of systems architecture. The manned-unmanned teaming approach will be implemented as part of this design. Advanced Technology Development for the UCAR is funded in FY04 and beyond in PE 0603003A Aviation Advanced Technology.</p>	6000	10000	0	0

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PROJECT
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Accomplishments/Planned Program (continued)

National Rotorcraft Technology Center (NRTC) - In FY02, conducted component maturation / test / validation and transition of technology to NRTC government / industry partners. Conducted focused research on unmanned rotorcraft applications, rotorcraft aerodynamics, and rotorcraft performance improvement. In rotorcraft flight controls, matured carefree maneuvering technology and limited authority flight control technology. In rotorcraft structures, matured damage tolerance and structural joining technologies. Performed NRTC advanced technology maturation efforts in improved bevel gear design concepts, advanced transmission technology, Health and Usage Monitoring (HUM) smart transducer data bus maturation, composite durability and damage tolerance, and integrated helicopter design technology. In FY03, conduct component research in the areas of rotorcraft aerodynamics, rotorcraft performance improvement, limited authority flight control technology, damage tolerance, crashworthiness and advanced structures, and advanced low-cost composite manufacturing. Perform NRTC applied research efforts in improved bevel gear design concepts, HUM smart transducer data bus research, composite durability and damage tolerance, and integrated helicopter design technology. In FY04, conduct component research in the areas of rotorcraft performance improvement, limited authority flight control technology, damage tolerance, crashworthiness and advanced structures, advanced low-cost composite manufacturing, structural joining technologies, and rotorcraft transmission technologies. Perform NRTC applied research efforts in improved bevel gear design concepts, HUM smart transducer data bus research, composite durability and damage tolerance, and integrated helicopter design technology. In FY05, conduct component research in rotorcraft performance improvement, limited authority flight control technology, damage tolerance, and rotorcraft transmission technologies.

FY 2002	FY 2003	FY 2004	FY 2005
6651	6519	6984	7192

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>Rotor Technology –Includes Low Cost Active Rotor (LCAR) program. In FY02, evaluated active on-blade control loads modeling upgrade for application to advanced design requirements and bench-tested advanced actuator concept for washplate-less rotor applications. Measured in-flight acoustics for rotor gust response and slung-load stability and handling qualities experiments. Performed research simulations on rotor gust / rejection and partial-authority digital flight control systems. Modified and instrumented flight research vehicle for performing gust response measurement and slung-loads stability research. Conducted soft-in-plane tilt-rotor dynamically scaled wind tunnel test or concept evaluation for manned and unmanned rotorcraft. Completed in-flight simulator envelope expansion and research control system flight development and qualification. In FY03, establish loads and affordability baselines for the washplate-less rotor geometry and design rotor for the washplate-less concept. In FY04, design model rotor to demonstrate 40% vibration reduction and control system weight savings. In FY05, fabricate a washplate-less rotor model and initiate model scale testing.</p>	10658	3911	4288	3906
<p>Survivability - In FY02, built and validated super lightweight thermal insulation components that reduce density by 50% over current state-of-the-art COTS insulation. Conducted analytic screening of advanced aircraft camouflage designs that reduce visual signatures in both desert and vegetated environments by 50% compared to current coatings. In FY03 fabricate and ground test prototype reactive engine IR suppression system that reduces thermal signatures by 90% over currently suppressed aircraft, while eliminating engine performance penalties during non-threat operations. In FY04, conduct UAV full-spectrum threat susceptibility assessment. Define radar frequency/infra-red/electro-optic/visual/acoustic signature requirements for survivable UAV operations. In FY05, develop and demonstrate fully automatic reactive infrared suppressor control system, utilizing Common Missile Warning System (CMWS) and T-700 Digital Engine Control Unit (DECU).</p>	3217	3743	3692	3795

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602211A - AVIATION TECHNOLOGY

PROJECT
47A

Accomplishments/Planned Program (continued)

Structures and Airframe – Includes Survivable, Affordable, Repairable Airframe Program (SARAP). In FY02, designed, modified, tested full-scale landing gear shock strut to increase AH-64 hard landing capability from 7 to 12 feet per second rate of decent. Performed detailed design of structures actuators capable of reducing airframe vibration loads at 50% less weight compared to current capability. Completed full-scale hardware testing of "smart" piezo-ceramic and elastomeric vibration isolation devices for total airframe vibration reduction. Completed full-scale hardware tests of composite design that reduced RAH-66 empennage assembly labor cost by 713 hours (52%) and weight by 6.6 pounds (6%). In FY03, conduct hardware testing to demonstrate 5% reduced airframe weight for multi-mission rotary-wing UAV with adaptive payload vibration control. Evaluate and select the design and certification standards and methods specific to rotary-wing UAVs that allow enhanced agility at reduced cost and weight. In FY04, design and fabricate smart re-configurable airframe and rotors structures for bench tests. Investigate hyper-responsive metering valves for smart, adaptive landing gears and other hydraulic systems. In FY05, validate and disseminate improved loads determination tools that are 25% more accurate. Design and fabricate smart re-configurable airframe and rotors structures for bench tests.

FY 2002	FY 2003	FY 2004	FY 2005
2366	2322	2624	2446

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602211A - AVIATION TECHNOLOGY

PROJECT
47A

Accomplishments/Planned Program (continued)

Propulsion – Includes the Integrated High Performance Turbine Engine Technology (IHPTET) program. In FY02, validated lightweight, high-strength Metal Matrix Composite (MMC) shaft for Joint Turbine Advanced Gas Generator (JTAGG) III technology demonstrator. Upgraded simulation software/hardware and performed final closed loop bench test of advanced fuel control. Designed and fabricated advanced inlet particle separator providing increased separation efficiency and reduced engine losses and Operating and Support (O&S) costs. Designed 500 horsepower class compressor for improved full and part power performance. In FY03, fabricate and rig test advanced inlet particle separator providing increased separation efficiency and reduced engine losses and O&S costs. Fabricate advanced power turbine providing increased cycle efficiency and reduced engine weight. Design and fabricate 500 horsepower class compressor for improved full and part power performance. Design 500 horsepower class, heavy-fuel turbine providing increased cycle efficiency and reduced engine weight and production cost. In FY04, conduct rig test of advanced inlet particle separator providing increased separation efficiency and reduced engine losses and O&S costs. Conduct initial rig test and aero redesign of advanced power turbine providing increased cycle efficiency and reduced engine weight. Conduct rig test of 500 horsepower class compressor for improved full and part power performance. Fabricate 500 horsepower class turbine providing increased cycle efficiency and reduced engine weight and production cost. Design a small lightweight combustor providing increased temperature capability for reduced fuel consumption, reduced costs, and improved power/weight. In FY05, conduct final rig test of advanced power turbine providing increased cycle efficiency and reduced engine weight. Conduct rig test of 500 horsepower class compressor for improved performance.

FY 2002	FY 2003	FY 2004	FY 2005
1689	1651	1379	1431

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602211A - AVIATION TECHNOLOGY

PROJECT
47A

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>Networked Operations and System Integration - In FY02, performed preliminary simulation/flight test validation of autonomous guidance control laws using unmanned rotorcraft. Validated the significant improvement in agility and all-weather operations using advanced control laws in the Rotorcraft Aircrew Systems Airborne Laboratory (RASCAL), a UH-60 Black Hawk test bed demonstrator. Installed test monitoring equipment on aircraft and performed flight test planning for passive external load stabilization. Conducted wind tunnel test of integrated flight/rotor control using on-blade flaps. In FY03, research autonomous control laws and operator interface for small scale UAV rotorcraft. Research control system/handling qualities criteria for Objective Force rotorcraft, to include tilt-rotor. Define display research / evaluation methodology for associated unmanned aerial vehicle aeronautical design guide. Define control law architecture, performance criteria, and simulate precision autonomous landing of UAVs. Conduct research for candidate autonomous modes of operation for UAV. In FY04, conduct requirements analysis and concept definition studies for multi-UAV control to handle multiple integrated mission operations. Evaluate control law/sensor optimization in simulation for precision autonomous landing of UAVs. Modify RMAX rotorcraft surrogate UAV for precision autonomous landing experiments. Produce UAV aeronautical design guide. In FY05, conduct preliminary design of UAV "swarm" control for vehicle/mission equipment/flight management architectures. Evaluate system performance/effectiveness/risk. Prepare specification for control law/sensor optimization for precision autonomous landing of UAVs. Research autonomous control laws and operator interface for UAV cargo rotorcraft/sling load handling qualities. Prototype a UAV operator control station that can be worn by the soldier.</p>	7232	7853	16722	19341
Totals	37813	35999	35689	38111

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602211A - AVIATION TECHNOLOGY						PROJECT 47B	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
47B VEH PROP & STRUCT TECH	3482	3694	3770	3775	4063	4131	4169	4277

A. Mission Description and Budget Item Justification: The Vehicle Propulsion and Structure Technology project investigates engine, drivetrain and airframe technologies for Army / DoD rotorcraft specific to the Objective Force. 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 vehicles’ logistics footprint for unmanned and manned 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 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, incomplete loads/usage data, and inaccurate inspection and tracking methodologies. Technical solutions are pursued through propulsion and structures research– with a focus on applications towards UAV technologies while supporting manned 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 integrated high performance turbine engine technology (IHPTET) / Joint Turbine Advanced Gas Generator (JTAGG) 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 Army Research Laboratory (ARL), located at facilities at the NASA Glenn Research Center, Cleveland, OH and the NASA Langley Research Center, Hampton, VA performs work in this project. This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602211A - AVIATION TECHNOLOGY

PROJECT
47B

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Rotor & Structure Technology - In FY02, evaluated thermal nondestructive evaluation (NDE) experiments on bond line geometry and strength. Investigated low cost, lightweight airframe concepts for large scale, pressurized fuselages. Investigated preliminary Low Cost Active Rotor (LCAR) concepts for "Full Authority" control to eliminate need for rotor swashplates. Performed initial evaluation of Active Twist Rotor (ATR) potential for UAVs and completed assessment of 'closed-loop' ATR control actuation capability. In FY03, investigate reliability-based design methods, durability and damage tolerance analysis techniques and non-contacting NDE methods for UAV rotorcraft structures. Investigate advanced comprehensive design concepts for "Full Authority" on-blade active control rotor system. Acquire smart actuator materials for advanced ATR in support of the LCAR program. In FY04, conduct experiments and validate reliability-based design methods, durability and damage tolerance analysis methods, crashworthy concepts, and NDE methods on selected airframe and rotor hub UAV components. In FY05, conduct wind tunnel experiments on advanced "smart rotor" concept. Conduct analytical study of tiltrotor concept applicability to UAV applications. Evaluate soft-inplane hub for application to large rotorcraft design advanced tiltrotor UAV concept.</p>	1666	1745	1859	1850
<p>Propulsion & Drive Train Technology - In FY02, assessed and validated methods for extending the stable operating range of the centrifugal compressor stage, including microelectromechanical systems (MEMS) air injection technology. Completed baseline experiments of a unique, high speed/high temperature gas path seal rig to reduce engine secondary air flow losses leading to improved engine fuel efficiency and performance. In FY03, conduct experiments on a compact high performance two-stage engine compressor to reduce engine weight. Evaluate cooled monolithic ceramic and ceramic matrix composite turbine nozzles to achieve more fuel-efficient high temperature engine operation. In FY04, analyze the performance of a compact high performance two-stage engine compressor and cooled monolithic ceramic and ceramic matrix composite turbine nozzles. Research full 3-dimensional distributed propulsion simulation. In FY05, conduct experiments and computer simulation of active stall control technology to extend stable engine operation. Investigate autonomous propulsion system technology for future UAV propulsion control and operation.</p>	1816	1949	1911	1925
Totals	3482	3694	3770	3775

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A - EW TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	16427	17303	17029	17923	20803	20636	16341	16675
442 TACTICAL EW TECHNOLOGY	9440	9889	10692	11621	13150	13358	9534	9718
906 TAC EW TECHNIQUES	6987	7414	6337	6302	7653	7278	6807	6957

A. Mission Description and Budget Item Justification: This Program Element (PE) researches and investigates electronic warfare (EW) technologies to improve the Army's Objective Force battlespace survivability, enemy targeting capability and situational awareness (SA). This will be accomplished through the investigation of electronic support measures (ESM), threat warning and countermeasures against munitions, missiles, booby traps, missiles and target acquisition sensors. It will provide deployed Objective Force elements with information dominance and increased force protection. The intent of the PE is to deny, disrupt, or degrade the enemy's use of the electromagnetic spectrum for offensive or defensive operations. Specifically, its technologies focus on the threat emitters associated with weapon guidance 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), and ultra-violet (UV) ranges. In addition, this PE offers improvements to our EW sensors, and electronic countermeasures (ECM) systems to further protect high-value ground targets, aircraft, and the soldier from threat surveillance/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. Finally, this PE will research automated intelligence fusion and automated battlefield assessment management tools. Science and Technology Objectives (STOs) covered by this PE include Warfighter Electronic Collection and Mapping, Electronic Support for the Objective Force, Advanced Radar Deception and Countermeasures, Advance EW Sensors, EO/IR Countermeasures, Tactical Command and Control (C2) Protect Advanced Technology Demonstration, Sensor Countermeasures for the Objective Force, Fusion Based Knowledge for the Objective Force, Networked Sensors for the Objective Force, Information Operations for the Objective Force and Joint Intelligence, and Surveillance and Reconnaissance (JSR). This PE supports and is fully coordinated with efforts in PE 0602782A (Command, Control and Communications (C3) Technology), PE 0602709A (Night Vision and Electronics-Optics Technology), PE 0603789F (C3 Intelligence Technology Development), PE 0603270A (Electronic Warfare Advanced Technology), PE 0604270A (Electronic Warfare Development), and PE 0603745A (Tactical Electronics Support Systems - Advanced Development). The work cited is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command, Fort Monmouth, NJ. This program supports the Objective Force transition path to the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A - EW TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	17292	19584	20448	21257
Current Budget (FY 2004/2005 PB)	16427	17303	17029	17923
Total Adjustments	-865	-2281	-3419	-3334
Congressional program reductions				
Congressional rescissions		-2054		
Congressional increases				
Reprogrammings	-723	-100		
SBIR/STTR Transfer	-142	-127		
Adjustments to Budget Years			-3419	-3334

Change Summary Explanation:

Significant Changes:

Funding - FY 2004/2005: Funds realigned to higher priority investments.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602270A - EW TECHNOLOGY						PROJECT 442	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
442 TACTICAL EW TECHNOLOGY	9440	9889	10692	11621	13150	13358	9534	9718

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 vehicle survivability approach will provide detection avoidance through signature management and hit avoidance using warning receivers and 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 booby traps, radar directed target acquisition systems, target-tracking sensors, Surface-to-Air Missiles (SAMs), Air-To-Air Missiles (AAMs), top attack weapons and fuzed munitions. The ability to neutralize booby trap improvised explosive devices (IEDs) will be researched with the goal of embedding the maximum capability in projected FCS/Objective 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. The Warfighter Electronic Collection and Mapping (WECM) program will provide the unit level warfighter the ability to locate enemy tactical RF emitters. The Electronic Support for the Objective Force (ESOF) effort will demonstrate a light weight, low cost Unmanned Ariel Vehicle (UAV) and Unattended Ground Sensor (UGS) Electronic Support Measure (ESM) capability enabling them to collect, identify, locate and tract "hard-to-detect" communications and radar emitter not addressed by space, airborne or ground based intelligence systems. The Tactical Aircraft Self Defense program will investigate new EW technology that will deceive an enemy's radar based sensors and neutralize their ability to locate, target and guide weapons against early entry forces and the Objective Force. It also investigate cost-effective sensors for use in missile warning systems (MWS) for protecting Army ground combat vehicles and aircraft from gunfire, rocket propelled grenades (RPGs), SAMs, top attack (TA) weapons and antitank guided missiles (ATGMs). The Electro-optic and Infrared (EO/IR) Countermeasures program investigates active and passive devices to protect aircraft and ground vehicles with conventional and suppressed signatures from EO and IR guided threats. The Sensor Countermeasures for the Objective Force (SCOF) will investigate a multi-functional on the move (OTM) capability to detect, locate, deceive and jam enemy netted ground and airborne sensors, communications, IEDs, artillery fuzes, and battlefield surveillance radar. 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). This project supports the Objective transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) were provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A - EW TECHNOLOGY

PROJECT
442

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>This effort researches technologies that enable battlefield electronic collection and mapping, and electronics support for the objective force. In FY 02, researched techniques to detect, identify, and locate enemy tactical radio frequency emitters and conducted multiple evaluations of signal processing algorithms for signal detection identification and geolocation. In FY03, research and investigate new design concepts for a Signals Intelligence (SIGINT) sensor that will provide the capability to detect the emerging low probability of detection (LPD)/low probability of intercept (LPI) communications waveforms that will threaten the Objective Force. In FY04, pursue advanced simulation capabilities to define the utility of unattended ground and air vehicle sensors. Investigate designs that integrate digital receivers into antenna elements to reduce sensor size and weight and still increase dynamic range and instantaneous bandwidth of the receivers. In FY05, provide advanced simulation capability to refine the operational utility of unattended ground and air vehicle SIGINT sensors in the Mounted Maneuver Battlespace Lab at Fort Knox and continue sensor, antenna and receiver design efforts.</p>	1498	1566	2723	3329
<p>Tactical Aircraft Self Defense: In FY02, researched techniques against frequency hopping air defense radars and top attack munitions. Conducted Systems Integration Lab (SIL) testing of countermeasures against artillery top attack fuzes. In FY03, conduct lab and controlled field testing on new techniques to counter frequency hopping air defense radars and top attack munitions. Establish techniques for an enhanced ground vehicle and aircraft protection suite to simultaneously counter multiple advanced RF threats. In FY04, test countermeasure techniques against LPI and battlefield surveillance radars in the laboratory and in a controlled field environment. These techniques will attempt to jam top attack munitions, artillery and anti-aircraft artillery fuzes causing 90% prefunction of all rounds significantly beyond the lethal distance of the round.</p>	3260	2582	2711	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A - EW TECHNOLOGY

PROJECT
442

Accomplishments/Planned Program (continued)

This effort researches and investigates technologies that enable Electro-optic (EO)/Infrared (IR) Countermeasures and Advanced Electronic Warfare using Sensors. In FY02, Researched multispectral laser to defeat advanced IR surface-to-air and imaging missiles, transitioned warning algorithms for two-colored, antitank guided missile (ATGM) focal plane array (FPA) missile warning program to an on-going integrated countermeasure program in PE 0603270A. Demonstrated in laboratory environment IR countermeasure techniques for advanced ATGMs and emerging surface-to-air and air-to-air missiles, including FPA imaging missiles. Tested and evaluated cooperative jamming and decoy/flare techniques to support integrated countermeasure technology demonstration, and established threat and clutter signature database for algorithm investigation. In FY03, improve IR jamming techniques to defeat advanced ATGMs, and evaluate the capability of an IR jamming system to defeat ATGMs, evaluate the ability of a multispectral mid-IR laser to defeat advanced IR SAMs and IR imaging missiles, integrate and test a system of new low cost sensor and warning algorithms for protection of air and ground platforms against missiles. Conduct field measurements of IR and UV signatures of SAMs, ATGMs, background and manmade point false alarm sources. Research new techniques to increase detection, identification and classification of "background clutter" signals.

FY 2002	FY 2003	FY 2004	FY 2005
4682	4840	1834	2699

Sensor Countermeasures for the Objective Force (SCOF): In FY03, Characterize the emerging threat from Improvised Explosive Devices (IEDs)/booby traps and investigate key sensor component technologies (highly sensitive RF receivers and antennas that can quickly scan multiple octaves) in support of a modular, multi-spectral UV/IR sensor required for multiple Objective Force systems. In FY04, pursue acquisition of exploitation techniques for those threat sensors, begin lab testing of detection and jamming algorithms. Conduct modeling and simulation, laboratory and controlled field-testing of detection, location, deception and countermeasure techniques against threat sensors and booby traps. Assess potential for embedding a capability in existing and near term systems. In FY05, collaborate with other US and foreign government agencies on threat and countermeasure techniques. Conduct deception and jamming technique research, investigate model hardware and software. Expand investigation and conducting field testing of against RF and IR IED links.

0	901	3424	5593
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Totals	9440	9889	10692	11621
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A - EW TECHNOLOGY

PROJECT
906

COST (In Thousands)	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
906 TAC EW TECHNIQUES	6987	7414	6337	6302	7653	7278	6807	6957

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 Objective 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 C4I 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, and brigade level joint intelligence, surveillance and reconnaissance (JISR) assets to provide useful information to the Unit of Action (UA) without overloading the operator with non-essential details. Fusion and dissemination efforts will integrate data from traditional intelligence sensors and non-traditional sources, such as target acquisition systems, to provide ground force commanders unprecedented battlefield awareness and dominance of the electro-magnetic spectrum. The Tactical C2 Protect ATD will investigate, integrate, validate and demonstrate hardware and software that protects the systems and networks of the First Digitized Division and Future Combat Systems from modern network attacks. The Warfighter Electronic Collection and Mapping (WECM) program will provide the warfighter at the unit level the ability to locate enemy tactical RF emitters. The Joint Intelligence, Surveillance and Reconnaissance (JISR) program will provide the warfighter a comprehensive near real-time view of ISR information based on both traditional and selected non-traditional sensors to enhance situation awareness at all echelons. Investigate a new generation of low cost distributed unmanned networked sensor systems organic to the RSTA team. The Information Operations for the Objective Force effort provides a Unit of Action (UA) an on-the-move (OTM) capability for precision detection and location of commercially available wired and wireless telecommunications and computers in an urban environment. The Electronic Support for the Objective Force (ESOF) STO will demonstrate a light weight, low cost UA V and UGS Electronic Support Measure (ESM) capability enabling them to collect, identify, locate and tract "hard-to-detect" communications and radar emitter not addressed by space, airborne or ground based intelligence systems. The Fusion Based Knowledge for the Objective Force (FbKOF) STO will investigate an advanced knowledge generation and explanation capability to answer warfighting commanders' priority intelligence requirements (PIRs), enabling the force to see and understand at a rate supporting tactical agility concepts of the Objective Force. This system supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

No Defense Emergency Response Funds (DERF) were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A - EW TECHNOLOGY

PROJECT
906

Accomplishments/Planned Program

	FY 2002	FY 2003	FY 2004	FY 2005
- Joint Intelligence, Surveillance and Reconnaissance (JISR): In FY02, completed software to integrate existing joint and national intelligence sensors into a common format for JISR ACTD. Assessed improved JISR system performance and military utility in several tactical field exercises. In FY03, conduct experiment with high fidelity modeling and simulation of all-source sensor correlation that uses advanced data mining web applications to minimize volume of network data traffic. Conduct experiment with military operators to optimize user interfaces in support of JISR ACTD. Demonstrate Initial Operational Capability (IOC) and begin transition to the objective system. Additional funding for this program is contained in PE 0603270A.	2000	1458	0	0
- Information Operations for the Objective Force (IOOF): In FY02, Completed limited RF radio control strategy. In FY03, determine/characterize typical wireless network protocols and traffic analysis algorithms. In FY04, determine wired digital traffic analyses algorithms. Investigate inadvertent emissions analysis techniques to increase detection range. Provide models of preliminary threat and C4ISR detection systems to battlelabs at Fort Huachuca, Fort Knox, and Fort Leavenworth. In FY05, identify and test techniques to cross cue/correlate RF emission geolocations and Internet Protocol (IP) virtual address locations in lab environment.	500	2941	1818	2482
This effort researches and investigates EW sensors and electronics signal processing technologies. In FY02, completed modeled emitter identification and geolocation software for Future Combat Systems software radio. Refined algorithm design based on test performance. Simulated sensor function embedded in vehicle radio in Future Combat Systems experiments at Mounted Maneuver Battlespace Lab at Ft. Knox, completed limited RF controller/radio control strategy. In FY03, investigate software algorithms for unmanned Electronic Support Measures (ESM) signals intelligence (SIGINT) sensor systems that include unattended ground and air vehicle applications for the Future Combat Systems and Divisional Tactical SIGINT Payload (DTSP). In FY04, design compact RF receiver architectures that will enable the deployment of remote, unmanned ESM/SIGINT sensors and enhance the effectiveness of the Objective 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 Objective Force ATD communications equipment.	4487	2044	4519	3820
- Fusion Based Knowledge for the Objective Force (FbKOF): In FY03, identify technical issues associated with data fusion models for application to an advanced knowledge generation capability to answer time critical priority intelligence reports (PIRs) at a rate supporting tactical agility concepts of the Objective Force.	0	971	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A - EW TECHNOLOGY

PROJECT
906

Accomplishments/Planned Program (continued)

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Totals	6987	7414	6337	6302

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	58855	53308	43269	50407	58650	47552	45293	39346
214 MISSILE TECHNOLOGY	52621	46729	31372	35662	43944	35794	37443	39346
223 AERO-PROPULSION TECHNOLOGY	6234	4576	0	0	0	0	0	0
340 SWORD	0	2003	0	0	0	0	0	0
G02 NATIONAL AEROSPACE INITIATIVE APPLIED RESEARCH	0	0	11897	14745	14706	11758	7850	0

A. Mission Description and Budget Item Justification: This applied research program element investigates advanced technologies for missiles, rockets, and unmanned vehicles for use in the Objective Force, including the Future Combat Systems (FCS). 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. Major technology areas include missile guidance systems, air defense acquisition systems, multi-spectral seekers, high fidelity simulations, missile aerodynamics and structures, missile propulsion, hypervelocity compact kinetic energy missile efforts and the development of a common high-g, low cost, Micro Electro-Mechanical Systems (MEMS) Inertial Measurement Unit (IMU). The high-g MEMS IMU program will provide affordability and precision to missile and munitions guidance. 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). The Compact Kinetic Energy Missile (CKEM) program transitioned from Applied Research (6.2) in FY02 to Advanced Technology Development (6.3) demonstrations in FY03. The advanced technology demonstrations will be conducted under PE 0603313A (Missile and Rocket Advanced Technology). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan (AMP). The program element contains no duplication with any effort within the Military Departments. Work is performed at the Aviation & Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL. This PE supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	61085	31884	36743	39208
Current Budget (FY 2004/2005 PB)	58855	53308	43269	50407
Total Adjustments	-2230	21424	6526	11199
Congressional program reductions				
Congressional rescissions		-2522		
Congressional increases		25350		
Reprogrammings	-888	-309		
SBIR/STTR Transfer	-1342	-1095		
Adjustments to Budget Years			6526	11199

Change Summary Explanation:

Significant Changes:

Funding - FY 2004/2005: Funds investments in OSD's National Aerospace Initiative (NAI) for hypersonics engine exploration.

FY03 Congressional Adds:

Quantum Optics, Project 223 (\$1000); MEMS Technology Development Acceleration, Project 214 (\$12750); LENS Facility Modifications for Advance Testing of Endo- and Es-Missile Interceptors and Launch Vehicles, Project 223 (\$1000); Multiple Component Army Flight Test, Project 214 (\$2550); MEMS IMU/M-Code GPS, Project 214 (\$1750); E-STRIKE Short range air defense radar, Project 340 (\$2100); Jet Interaction CFD Testbed (\$2800); Advanced composite chassis, Project 214 (\$1400)

Projects with no R-2A:

(\$2003), SWORD: E-Strike Short Range Air Defense Radar. Project 340: The objective of this one-year Congressional Add is to design a lightweight multipurpose radar based on interferometric radar technology. No additional funding is required to complete this project.

(\$954), Quantum Optics, Project 223: The objective of this one-year Congressional Add is to investigate concepts for optical remote sensing, quantum computation encryption and coding and navigation systems. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

(\$953), LENS Facility Modifications for Advance Testing of Endo- and Exo-Missile Interceptors and Launch Vehicles, Project 223: The objective of this one-year Congressional Add is to design modifications for the LENS facility to employ in the large-scale Shock-Tunnel/Ludweig Tube Facility at the Army's Aero-thermal and Aero-Optics Evaluation Center. No additional funding is required to complete this project.

(\$2669), Jet Interaction CFD Testbed, Project 223: The objective of this one-year Congressional Add is to perform Computational Fluid Dynamics (CFD) tests to explore hypervelocity aero-propulsion effects at endo-atmospheric attitudes. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602303A - MISSILE TECHNOLOGY						PROJECT 214	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
214 MISSILE TECHNOLOGY	52621	46729	31372	35662	43944	35794	37443	39346

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 FCS and Objective Force. 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. 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-g, low cost MEMS 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, Mid-Range Munition (MRM), and Multi-Role Armament and Ammunition System (MRAAS). This is a joint program with the Armament Research, Development and Engineering at Picatinny Arsenal. Another major effort in this project was the CKEM program, which ended its 6.2 work in FY02. As efforts in this project mature, work is transitioned to PE 0603313A (Missile and Rocket Advanced Technology). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan (AMP). The program element contains no duplication with any effort within the Military Departments. Work is performed at the Aviation & Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

PROJECT
214

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- High-G MEMS IMU - In FY02, performed detailed design and analysis of first generation devices, incorporating emerging results from development effort. Constructed, evaluated, and refined manufacturability processes to begin production automation and process control maturation. In FY03, mature and live-fire test IMUs to meet the following parameters: Gyro Bias <75 deg/hr, Vol <8 cu. in., Accel <9mg, Gun-Hardened to 10,000g. In FY04, mature and live-fire test IMUs to meet the following parameters: Gyro Bias <20 deg/hr, Vol <4 cu. in., Accel <4mg, Gun-Hardened to 20,000g. Test units by live firings resulting in TRL5. In FY05 build and test interim IMU with integrated GPS in laboratory and missile environments	9379	10000	8900	14000
- High-g MEMS/IMU Technology Development Acceleration- The purpose of this Congressional interest item is to support the integration of deeply integrated GPS prototypes into first generation hardware for testing and research and test GPS anti-jam hardware	7000	12263	0	0
- MEMS IMU/M -Code GPS - The purpose of this Congressional interest item is to accelerates the development of MEMS IMU/M -Code GPS development	0	1693	0	0
- Low-Cost Guidance and Navigation Unit - This Congressional add provided research into a deeply integrated GPS/IMU.	4819	0	0	0
- CKEM - In FY02, successfully conducted full-scale (~5', 105lb) unguided CKEM technology testbed flight tests at Eglin, AFB. Achieved test goals include gathering velocity data, data relating to missile electronics operations and survivability, guidance link transmissibility, and target tracker information. Tested both radio frequency (RF) and electro-optic guidance techniques for CKEM. Successfully performed and simulated multiple full-scale lethality tests of novel penetrators and lethal mechanism components to evaluate target penetration, perforation and secondary lethal effects. Testing, modeling, and simulation have proven that a small, lightweight kinetic energy missile can provide lethality overmatch against current tanks and future advanced threat armor. This technology effort transitioned to 0603313 Missile and Rocket Advanced Technology at the end of FY02	10295	0	0	0
- CKEM IMU - The purpose of this Congressional interest item is risk reduction and maturation of an alternative design approach for the CKEM IMU. No additional funding is required to complete this project.	1000	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

PROJECT
214

Accomplishments/Planned Program (continued)

- Missile Guidance Systems and Seeker Technology - In FY02, tested MEMS-based angular rate sensors (ARSs) that incorporate technology developed by DARPA. Tested in the laboratory and in a relevant environment both the MEMS-based ARS and the single axis roll rate sensor. MEMS-based angular rate sensors (ARSs) are able to meet hypervelocity missile high-g operational requirements with a low cost small component. Designed an optical test bed to evaluate advancements in uncooled detector technology. Investigated concept designs for uncooled IR sensor for missile applications. In FY03 integrate MEMS-based angular rate sensors and roll rate sensor into a three-axis rate package, test and transition to FCS and industry. By the end of FY05 mature controlled arrays of MEMS sensors to provide full dynamic performance ranges for miniature sensing systems, focusing on inertial applications. Design geometry transformations for rapid retraining of automatic target recognition (ATR) systems that will allow precision strike of a target from a different direction than it was originally detected. Devise hardening techniques and algorithms for IR seekers to defeat laser counter-countermeasures (CCM). By the end of FY04 perform laboratory tests of IR CCM guidance algorithms in a seeker. By the end of FY05 perform field tests of IR CCM guidance algorithms in a seeker. Demonstrate concepts of advanced uncooled infrared seeker and sensor hardware. Design, mature, and test advanced optics, signal processing, and guidance and control techniques utilized in uncooled imaging infrared seeker and sensor packages. Conduct captive carry tests of prototype uncooled seeker and sensor systems (TRL 5) in FY05, and transfer optical and electronic technology (TRL 5) in FY05.

FY 2002	FY 2003	FY 2004	FY 2005
7874	6238	8202	8594

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

PROJECT
214

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- High Fidelity System Level Simulations and Aerodynamics - In FY02, designed signal generation capability for infrared (IR) LADAR Hardware-in-the-loop (HWIL) simulation; designed cold chamber background for IR target simulation; continued design and build of target signature databases. In FY03, develop and improve target signature and background scenario modeling and simulation techniques for real-time hardware-in-the-loop system simulations and perform wind tunnel tests and missile aerodynamic predictions. Complete the investigation of an improved method of RF millimeter wave scatter extraction from measurements and validate "spinning tail" and "bent nose" aerodynamic predictions. In FY04 complete the development of a method of rapid infrared passive signature prediction using the MuSES code and initiate techniques for modeling target signatures as perceived by LADAR sensors; characterize supersonic/hypersonic aerodynamic missile controls and power-on base drag; initiate FCS missile geometry and thrust level prediction methodologies. In FY05 continue development of techniques for modeling target signatures as perceived by LADAR sensors; complete FCS missile geometries and thrust levels characterization.</p>	980	1000	2083	1720
<p>- Smart, Stealthy, Smokeless Missile Propulsion and Smart Structures - In FY02, completed design, fabricated and tested brassboard of a deep throttling booster controllable thrust technology, which increases range and provides multi-mission capability for a family of FCS and Objective Force weapon systems. In FY03 design, fabricate, and static test integrated deep throttling booster that extends the capabilities of controllable thrust technology to increase range and provide multi-mission capability for a family of FCS and Objective Force weapon systems. Mature controllable thrust components applicable to the 2.75-inch and smaller diameter family of rockets and deliver a validated Computational Fluid Dynamics (CFD) tool for designing compact thrusters. By the end of FY03, mature system level concepts, select one propulsion option and one pressurization option for brassboard evaluation, evaluate designs using CFD model, and begin design of component hardware (TRL 3). In FY04, complete design of, fabricate, conduct functional demonstration of critical components, and begin CFD model validation (TRL 4). In FY05, demonstrate components in brassboard hardware.</p>	2570	3720	3420	3670

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

PROJECT
214

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>- Focused Technology Integration - In FY02, integrated a fully functional Remote Readiness Asset Prognostics/Diagnostics System (RRAPDS) brassboard system. Evaluated RRAPDS as a Horizontal Technology Integration (HTI) candidate for a launch platform and a high value conventional munition. Evaluated ability to provide the user with target information on stationary and moving military vehicles using small unmanned aerial vehicles. Defined critical technologies for a 2.75 inch Advanced Miniature Multi-Role Precision Guided Missile (AMMPGM). In FY03, complete Phase I Feasibility Demonstration (TRL 4) and Phase II Interface Demonstration of Fire Control-Node Engagement Technology (FC-NET) including interim fire control computer virtual simulation testing, integration of the baseline missile target pairing algorithms and transition FC-NET to 0603313 Missile and Rocket Advanced Technology. In FY03, establish the best technical approach for the component technologies for AMMPGM. Transition AMMPGM to 0603313 Missile and Rocket Advanced Technology. In FY04, perform concept development and subsystem/component level development of supporting technologies of an air defense capability for the Unit of Action. In FY05, mature system concepts and complete initial system and component design of an air defense capability for the Unit of Action.</p>	6704	8016	8767	7678
<p>- LAM-A – This Congressional interest item fabricated and assembled long range loiter missiles airframe and seeker components and prepared for integration of prototype hardware for ballistic flight test. No additional funding is required to complete this project.</p>	2000	0	0	0
<p>- Multiple Component Army Flight Test - The purpose of this Congressional interest item is to design alternative test processes to verify advanced missile components in a ground test facility under duplicated flight conditions to avoid performing the actual expensive and difficult flight tests. No additional funding is required to complete this project.</p>	0	2453	0	0
<p>Advanced Composite Chassis - - The purpose of this Congressional interest item is to demonstrate the feasibility of using advanced, novel, lightweight composites for hypervelocity missile airframe > and support structures. No additional funding is required to complete this project.</p>	0	1346	0	0
Totals	52621	46729	31372	35662

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602303A - MISSILE TECHNOLOGY						PROJECT G02	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
G02 NATIONAL AEROSPACE INITIATIVE APPLIED RESEARCH	0	0	11897	14745	14706	11758	7850	0

A. Mission Description and Budget Item Justification: This project funds applied research to explore and mature the critical technologies required to develop expendable hypersonic cruise missiles and ballistic missiles. Primary technology focus areas are those deemed critical by the National Aerospace Initiative (NAI) to the advancement of national goals in hypersonic weapon development and access to space. These focus areas include scramjet engine development, hypersonic airframe aerodynamics and structures, thermal protection systems, active and passive cooling mechanisms, turbulent mixing enhancement at low Reynolds numbers, computational fluid dynamics, high yield storable fuel grain development and alternate methods of hypersonic missile guidance, navigation and control. Initial effort will focus on development of a gun-launched, scramjet engine powered projectile scalable to larger missile applications. Efforts will be conducted through detailed system and subcomponent simulation, design, development and test in laboratory and operational settings. Funding for this effort is provided in coordination with other DOD and government elements participating in NAI. As a result, numerous leveraging and technology insertion opportunities are available. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan (AMP). The program element contains no duplication with any effort within the Military Departments. Work is performed at the Aviation & Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- NAI Airframe: In FY04, trade studies of component designs including, inlet, nozzle, thermal protection system, fuel and coolant supply system and shroud will be initiated. Computational fluid dynamic analysis shall be performed in FY04 to identify airframe components under critical aero thermal stress at worst-case operational conditions. In FY05, design trade studies culminating in initial subcomponent designs will be completed; fabrication of subcomponent hardware will be initiated for use in structural and thermal analysis.	0	0	4550	2700
NAI Engine: In FY04, computational fluid dynamic analysis will be performed to develop initial engine flow path design. Design concepts for inlet, combustor, fuel injector, and mixing enhancement methodologies will be formulated. In FY05, design concepts for engine flow path subcomponents will be completed by end of fiscal year. Lab testing of possible fuel options will be initiated.	0	0	5247	10045

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

PROJECT
G02

Accomplishments/Planned Program (continued)

- NAI Hypersonic Launch: In FY04, initial feasibility study of gun-launched scramjet will be completed using computational fluid dynamic analysis. Results of analysis will be coupled with theoretical prediction to develop 6-DOF aerodynamic models to allow detailed simulation of event. In FY05, a detailed simulation analysis of separation event will be conducted to assess feasibility of separation concept; wind tunnel model design will be initiated.

FY 2002	FY 2003	FY 2004	FY 2005
0	0	2100	2000
0	0	11897	14745

Totals

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602307A - ADVANCED WEAPONS TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	25460	19976	14189	17560	20634	21047	21560	22051
042 HIGH ENERGY LASER TECHNOLOGY	15390	12113	14189	17560	20634	21047	21560	22051
04G MINIATURE DETECTION DEVICES & ANALYSIS METHODS	958	0	0	0	0	0	0	0
NA3 MICROELECTRO MECHANICAL SYSTEMS	7769	4050	0	0	0	0	0	0
NA5 RAPID TARGET ACQUISITION & TRACKING SYSTEM	1343	3813	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program matures technologies for the Army Transformation as related to High Energy Laser (HEL) weapon systems. Potential HEL weapon system missions in the areas of Information Dominance and Force Protection include countering airborne electro-optical sensors and defending against airborne threats, providing a new, low cost per shot, complement to conventional offensive and defensive weapons. This program will address technical issues such as high average power output from compact and more efficient lasers; precision optical pointing and tracking; laser influence degradation due to atmospheric effects; lethality; and effectiveness against low-cost laser countermeasures. A key project within this program is the development of a multi-hundred kilowatt (kW) solid-state laser (SSL) laboratory demonstrator. This project will demonstrate a 15-25 kW diode-pumped solid-state laser (SSL) breadboard in FY04. In FY04, the Army will evaluate this concept against alternative SSL technology approaches being supported by the High Energy Laser (HEL) Joint Technology Office (JTO) High-Power Solid-State Laser program. The most promising technology will then be upgraded to a 100kW SSL laboratory device, scheduled for completion in FY07. The project will continue to mature the selected SSL technology into a multi-hundred kW laboratory device. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work in this program element 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). 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. This PE supports the Objective transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602307A - ADVANCED WEAPONS TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	26883	11208	11312	17864
Current Budget (FY 2004/2005 PB)	25460	19976	14189	17560
Total Adjustments	-1423	8768	2877	-304
Congressional program reductions				
Congressional rescissions		-292		
Congressional increases		9750		
Reprogrammings	-691	-114		
SBIR/STTR Transfer	-732	-576		
Adjustments to Budget Years			2877	-304

Significant Changes:

FY04 - Funds increased investments in solid state laser efforts.

FY03 Congressional Adds:

Rapid Target Acquisition Tracking System (RTATS), Project NA5 (\$3813); MEMS for Defense Applications, Project NA3 (\$4050); High Intensity Laser Diode Arrays for SSHCL, Project 042 (\$1430)

Projects with no R-2A:

(\$3813) Rapid Target Acquisition & Tracking System, Project NA5: The objective of this one year Congressional add is to design/mature a brassboard with the critical elements of a rapid, passive infrared (IR) acquisition and tracking system for use in detection of fast, low signature threats such as Anti-Tank Guided Missiles (ATGM). No additional funding is required to complete this project.

(\$4050) Microelectro Mechanical Systems for Defense Applications, Project NA3: The objective of this one year Congressional add is to continue maturation of a chemical/physical analysis instrument suitable for harsh environments. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602307A - ADVANCED WEAPONS TECHNOLOGY

PROJECT
042

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
042 HIGH ENERGY LASER TECHNOLOGY	15390	12113	14189	17560	20634	21047	21560	22051

A. Mission Description and Budget Item Justification: This project matures technologies for Army Transformation relating to solid-state High Energy Laser (HEL) weapon systems. Potential HEL weapon system missions include defense against airborne threats and countering electro-optical sensors. This effort will develop and demonstrate a 15-25 kilowatt (kW) diode-pumped solid-state laser (SSL) breadboard in FY04. In FY04, the Army will evaluate this concept against alternative SSL technology approaches being supported by the High Energy Laser (HEL) Joint Technology Office (JTO) High-Power Solid-State Laser program. The most promising SSL technology will then be upgraded to a 100kW laboratory device, scheduled for completion in FY07. This project would continue to mature the selected SSL technology into a multi-hundred kW laboratory SSL device. The 100kW 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. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work in this program element 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). Work within this PE is performed by the US Army Space and Missile Defense Command (SMDC), in Huntsville, AL and the Army Test and Evaluation Command, White Sands Missile Range, NM. This PE supports the Objective transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602307A - ADVANCED WEAPONS
TECHNOLOGY

PROJECT
042

Accomplishments/Planned Program

Solid State Laser (SSL) Development: In FY02, demonstrated a 10 kW flashlamp-pumped Solid State Laser (SSL) based on a heat capacity laser design in a laboratory environment. Performed laboratory characterization of SSL performance, designed and tested an integrated active resonator design to improve system beam quality. Began conversion of the flash lamp pumped SSL into a laser-diode pumped device. In FY03, complete integration of the diode-pumped SSL breadboard to include an intra-cavity active resonator demonstration. In FY04, integrate thermal management system into the SSL concept and complete laboratory characterization of the laser device to include thermal cycling time, power management requirements, and beam quality over time and nominal ranges. This breadboard device will demonstrate the major aspects of power scaling, beam combining/quality/efficiency, that support the engineering analysis used in the technology selection process.

FY 2002	FY 2003	FY 2004	FY 2005
9680	8704	8712	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602307A - ADVANCED WEAPONS
TECHNOLOGY

PROJECT
042

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
<p>SSL Subcomponent Development: Laser crystal development - In FY02 began initial testing of SSL crystal response to diode laser pumping, developed and demonstrated production technology to create bulk crystal media (large). In FY03, demonstrate ability to grow high-quality, large diameter (>10cm) laser crystals. In FY04, reliably produce laser crystals, maintaining state-of-the-art crystal dislocation density while increasing crystal diameter by 50 percent. Laser diode development and production - In FY02, developed and demonstrated laser diode/cooler package production techniques (rack and stack) that halve the cost of the diode/cooler packages. In FY03, begin industrial effort for area scaling (monolithic array) of laser diode/cooler package. This technology enables the processing of multiple diode bars per cooler and reduces manpower requirements for assembly. In FY04, begin industrial effort to semi-automate production for additional cost reduction while increasing diode/cooler package life by 50%. Thermal management - In FY02 demonstrated the ability to maintain a uniform temperature across a simulated laser disk. Designed and demonstrated an alternative high cooling capacity system utilizing highly efficient mist-cooling/phase-change techniques. In FY03, maintain a uniform temperature (< 1oC) across a large bulk media crystal. Improve alternative mist-cooling thermal management system to enable a reduction in cool down time by a factor of five. In FY04, integrate scaled versions of thermal management system into SSL breadboards. Design and validate novel rotating disk approach for SSL thermal management. Beam control/atmospheric compensation - In FY02, assessed atmospheric effects and compensation on system lethality and size constraints. Completed preparation of Army Pointer Tracker (APT, former Airborne Laser Lab Beam Director retrofitted for SSL technologies) beam director for integration with 10 kW flashlamp pumped device.</p>	3510	3409	5477	0
<p>SSL System Engineering and Lethality Effects Study – System Engineering - In FY 02, completed thermal storage concept definition; conducted scenario analysis of SSL performance against threat of ATGM; and determined top-level system parameters required for an effective tactically mobile HEL weapon. Lethality - completed 10 kW flashlamp device characterization via beam target interactions; used those interactions to construct physics based model of laser effects.</p>	2200	0	0	0
<p>High Power SSL Development - In FY05, analyze results of competitive 25 kW SSL laboratory demonstrations; down select design, and initiate development of 100kW SSL. Begin procurement of several long-lead items, such as power supplies, crystal media, diode arrays and thermal management technologies. Develop brassboard components for 100kW laser prototype and begin integration.</p>	0	0	0	17560
Totals	15390	12113	14189	17560

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	30319	30150	15941	15643	16777	17331	17657	18115
C90 ADVANCED DISTRIBUTED SIMULATION	16113	13980	10658	10538	11060	11193	11370	11683
D01 PHOTONICS RESEARCH	2373	2382	0	0	0	0	0	0
D02 MODELING & SIMULATION FOR TRAINING AND DESIGN	6453	7123	5283	5105	5717	6138	6287	6432
D03 JOINT MODELING & SIMULATION SYSTEM (JMASS)	2502	2664	0	0	0	0	0	0
D14 COMBAT TRAUMA PATIENT SIMULATION PROGRAM (CTPS)	0	4001	0	0	0	0	0	0
MC8 THREE DIMENSIONAL ULTRASOUND IMAGING	2878	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 testing and training of the Future Combat Systems (FCS) and the Objective Force (OF). It develops 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. This program directs and stimulates advances in those technologies required for real time interactive linking within and among constructive, virtual, and live simulation and training by developing technologies for advanced distributed interactive simulation. This program 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 project will ensure the transition of the research results of the ICT into the Army technology base and future Army training products. These programs are 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 the new PE 0603015A (Next Generation Training & Simulation Systems). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Provisional Research Development and Engineering Command (RDE Command).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

This program element supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	31333	20634	23000	23298
Current Budget (FY 2004/2005 PB)	30319	30150	15941	15643
Total Adjustments	-1014	9516	-7059	-7655
Congressional program reductions				
Congressional rescissions		-703		
Congressional increases		11200		
Reprogrammings	-212	-173		
SBIR/STTR Transfer	-802	-808		
Adjustments to Budget Years			-7059	-7655

Change Summary Explanation:

Significant Changes:

FY04/05 - Funds realigned to Advanced Technology ICT and Modeling and Simulation efforts.

FY03 Congressional Adds:

Combat Trauma Patient Simulation Program (CTPS), Project D14 (\$4200); On-Line Contract Document Management, Project C90 (\$1000); Institute for Creative Technologies (Simulations for Capabilities for the Warfighter), Project D02 (\$3500); Photonics, Project D01 (\$2500).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)**February 2003****BUDGET ACTIVITY
2 - Applied Research****PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation**

Projects with no R2-A:

- (\$4001) Combat Trauma Patient Simulation Program (CTPS), Proj. D14: The objective of this one-year Congressional Add is to provide a CTPS prototype that advances the present CTPS system and system components. No additional funding is required to complete this project.
- (\$2382) Photonics, Proj. D01: The objective of this Congressional Add is to manufacture, assemble and characterize optical components and laser output for an unique fiber laser combiner. No additional funding is required to complete this project.
- (\$2664) Joint Modeling & Simulation System (JMASS), Proj D03: In FY03, the objective is to complete the JMASS simulation software development effort by bringing the Electro Optical/Infrared (EO/IR) environment player, Virtual Autonomous Teaming Tool (VATT), and the Helo Flares/Jammers Modules into JMASS compliance; distributing the software to users; providing the Army's portion of the first year configuration management effort; re-establishing the JMASS User Web Site; and transitioning the completed software to the JMASS sustainment program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

PROJECT
C90

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
C90 ADVANCED DISTRIBUTED SIMULATION	16113	13980	10658	10538	11060	11193	11370	11683

A. Mission Description and Budget Item Justification: This project applies enabling technologies for advancing distributed interactive simulation in a synthetic environment by maturing advanced distributed simulation technologies, such as networking of models, complex data interchange, and collaborative training. It will provide the representation of the battlefield needed to support the use of modeling and simulation as an acquisition and training evaluation tool and a virtual representation of a lethal combined arms environment with the warfighter-in-the-loop that constructive simulation cannot provide. This environment permits 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 matures 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 and interchange. Work is performed by the Provisional Research Development and Engineering Command (RDE Command). This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

PROJECT
C90

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Collaborative and Immersive Environment Technologies. In FY02, prototyped intelligent tutoring systems to provide soldier individualized instructional support of cognitive training tasks. Prototyped architecture for speech, gesture, and gaze integration into virtual humans. In FY 03, evaluate interface between learning management system, game engine assessment tool, courseware, and intelligent tutoring system to provide tailorable training in a web-based environment. Explore technologies to support intelligent tutoring in an embedded environment. Conduct research on 3-dimensional graphics, and photorealistic rendering of human features and motions to support realistic interactive simulation environments. Investigate simulation “engines” (operating systems to run simulations) that will support persistent interactive simulation over the internet and allow users to create unconventional threats. In FY 04, expand 3-dimensional advanced distributed learning environments to provide realistic training on the move. Prototype testbeds for distributed component simulations to support FCS and Objective Force Warrior (OFW) training missions. Investigate concepts for an embedded training decision aid utilizing 3-dimensional virtual environments. Apply rendering of human features and motions to interactive training environments. In FY 05, demonstrate 3-dimensional learning environment to support reachback capability. Demonstrate component simulations supporting FCS and OFW training missions. Expand high performance and large scale robotic simulations. Demonstrate 3-Dimensional and human features modeling simulations in an interactive training environment.</p>	4430	3033	3207	5988

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February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

PROJECT
C90

<u>Accomplishments/Planned Program (continued)</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Modeling and Simulation Training Technologies. In FY 02, completed advanced trauma patient simulation holographic airway visualization prototype. Prototyped trauma patient simulator interface to constructive simulation (OneSAF Testbed (OTB)). Prototyped personal computer based trainer to support initial experimentation at Fort Gordon, Georgia. Developed a composable robotics simulation testbed for capabilities analysis and behavior construction for FCS and established OTB baseline control of unmanned systems. In FY 03, experiment with trauma patient simulation components to verify interoperability across live, virtual, and constructive domains, including Multiple Integrated Laser Engagement System (MILES) XXI (live), Virtual Emergency Response Training System (VERTS - virtual), and Dismounted Infantry Semi-Automated Forces (DISAF). Extend the composable robotics simulation testbed through the addition of higher level mission behaviors and prototype man/machine interfaces to allow a single user to control multiple unmanned systems. In FY 04, conduct team performance assessment for multiple unmanned robotic systems and enhance robotic behavior interaction with use of intelligent agents. Includes multiple users controlling multiple robots in a coordinated team environment. Supports embedded simulation and training concepts for FCS and OFW. In FY 05, optimize robotic simulation behavior toolset and collaborative team behaviors at the FCS and OFW cell level to maximize the number of robots and complex robotic team behaviors that can be controlled by a single soldier.</p>	1735	1989	1951	0
<p>Embedded Training for Dismounted Soldiers. In FY 02, investigated and developed concepts for embedded training for dismounted soldiers. Established initial embedded training testbed utilizing commercial off the shelf and government furnished hardware components. In FY 03, extend testbed functionality and conduct experiments to evaluate proposed concepts for a mobile training network for dismounted soldiers. Investigate concepts for technologies to precisely track a soldier's location and weapon orientation inside/outside of buildings in order to support Military Operations in Urban Terrain (MOUT) at the FCS and OFW cell level. In FY 04, extend testbed functionality to include augmented reality (virtual targets, weapon effects, threats, and friendlies) for a mobile training network for dismounted soldiers. Mature embedded training through augmented reality. Prototype testbeds and algorithms to support assessment of tracking technologies. In FY 05, prototype mobile range and conduct experiments to evaluate an augmented reality training environment for the OFW cell level at Fort Benning, Georgia. Conduct experiments with advanced tracking testbed to validate/improve MOUT training.</p>	2902	2500	2800	1375

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February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

PROJECT
C90

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
RDEC Federation. In FY 02, developed JAVA middleware tool "cookbook" for interfacing industry models to the DoD's High Level Architecture (HLA) to allow quicker model incorporation into federations of interoperable simulations and training systems. In FY 03 Implement a Joint Virtual Battlespace (JVB)/RDEC Federation reference implementation architecture for interfacing with the FCS Advanced Collaborative Environment. Conduct analysis of interface requirements and identify human performance modeling requirements. Address and incorporate engineering-level M&S, virtual prototypes, and distributed requirements. Develop a concept of operations for reference implementation to support FCS and OF experimentation. Identify technologies from the ICT for incorporation into reference implementation. In FY 04 and beyond, this effort is funded in PE 0603015A, Project S31 (RDEC Federation).	505	3000	0	0
Rapid Generation of Synthetic Natural Environments. In FY 02, developed tools and improved synthetic natural environment (virtual terrain and 3-dimensional models/features) development processes. Tested methodologies to assess interoperability of shared synthetic environments for virtual, constructive, and live systems. Prototyped virtual immersive simulation system for dismounted soldiers to support MOUT. Researched technologies for rapid construction of urban terrain databases for training. Matured technologies for the modeling and simulation of asymmetrical warfare. In FY 03, investigate environmental data model representation of urban terrain structures (building components: windows, floors, rubble, etc.) to improve realism of virtual urban training environments. In FY 04, investigate toolsets to rapidly generate additional terrain structures in existing databases. Prototype simulation engine that will support persistent interactive simulation over the internet and allow users to create unconventional threats. In FY 05, assess performance of rapid generation technologies and recommend a standard toolset for OF training environments. Evaluate simulation engine that will support persistent interactive simulation over the internet and allow users to create unconventional threats.	1251	2500	2700	3175
Modeling, Simulation, and Training Infrastructure & Community Development. This one-year Congressional Add developed and demonstrated a concept for a learning management system, game engine assessment tool, courseware, and intelligent tutoring system to provide tailorable training in a web-based environment. No additional funding is required to complete this project.	4323	0	0	0
Online Contract Document Management. In FY 02, this Congressional Add developed, prototyped, and began testing three automated acquisition tools that mirror the DOD 5000 and FAR process. In FY 03, will continue the development of the automation for the acquisition process by integrating prototype tools with external legacy acquisition systems and an enterprise management system. No additional funding is required to complete this project.	967	958	0	0

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

PROJECT
C90

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Totals	16113	13980	10658	10538

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602308A - Advanced Concepts and Simulation					PROJECT D02			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
D02 MODELING & SIMULATION FOR TRAINING AND DESIGN	6453	7123	5283	5105	5717	6138	6287	6432	

A. Mission Description and Budget Item Justification: This project enables the rapid transfer and development of simulation and training research results to the Army from the Institute for Creative Technologies (ICT). The ICT provides research in modeling, simulation, and training technologies, such as immersive training, leadership development, and concept exploration. This project creates a true synthesis of creativity and technology by leveraging the capabilities of industry and the R&D community. It revolutionizes military training and mission rehearsal by making it more effective in terms of cost, time, types of experiences that can be trained or rehearsed, and the quality of the result. This project accomplishes this by maturing research in virtual humans to enable them to embody natural language, speech recognition in noisy environments, gesture, gaze, and conversational speech. This will make training applications widely available and enhance the Army's ability to train any time and any place. This project also investigates and matures techniques and methods for integrating different sensory cues into virtual environments to enhance training and leader development. This project investigates and matures the application of emerging photo-realistic rendering algorithms and 3-dimensional signal processing techniques to advanced experience learning applications. These efforts will mature the efficiency of 3-dimensional sound techniques in virtual environments. The environments will 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. These techniques and environments will impact education and training systems for the OF and enhance Army Transformation. Work is performed by the Provisional Research Development and Engineering Command (RDE Command). This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

PROJECT
D02

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Immersive Technology Environments. In FY 02, defined architectural structure for integrating speech, gesture, gaze, and speech synthesis into a virtual human. Also, began a concept demonstration in the use of virtual humans in advanced leader development environments. In FY 03, refine the architecture and identify research shortfalls for human to virtual human interactions. In FY 04, create solutions for shortfalls in human to virtual human interactions where feasible. Mature research approach for additional study to solve the more complex phenomena. In FY 05, collaborate with TRADOC to integrate virtual humans into leader training and the development advanced technology demonstrations.	2376	1366	2399	2400
Immersive Technology Techniques. In FY 02, integrated emerging photo-realistic rendering algorithms and 3-dimensional signal processing techniques into the Sensory Environment Evaluation (SEE) and Mentoring Prototype (MP) proof-of-principle venues. Collected and formatted audio data for integration into the SEE and MP experimental test beds at the ICT. In FY 03, incorporate algorithms developed by ICT into the next generation of personal computer graphics cards to make recent advances in computer graphics commercially available. Investigate and mature techniques for using low-cost training platforms like game-based consoles and emerging high-speed hardware. Complete development of personal computer based proof-of-principle and work on evaluation of proof-of-principle with TRADOC and ARI. In FY 04, provide concept demonstration of photo-realistic rendering of human faces and integrate into SEE and MP. Integrate audio and sensing cues implemented in algorithms and techniques into the SEE and MP. In FY 05, mature next generation global illumination algorithms and facilitate their adoption into military training applications.	4077	2421	2884	2705
Institute for Creative Technologies (Simulations for Capabilities for the Warfighter). The objective of this one-year Congressional Add is to conduct applied research in immersive environments to provide an enhanced simulations capability at Fort Sill. No additional funding is required to complete this project.	0	3336	0	0
Totals	6453	7123	5283	5105

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive Technology

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	109394	79952	80910	71108	72733	72206	59977	51183
C05 ARMOR APPLIED RESEARCH	15362	18153	19972	15514	10738	10946	11194	11452
C84 AC84	906	933	0	0	0	0	0	0
H77 ADV AUTOMOTIVE TECH	40711	22509	24999	21760	16620	16564	16870	17274
H91 TANK & AUTOMOTIVE TECH	19698	20534	35939	33834	45375	44696	31913	22457
HH7 FUTURE COMBAT SYSTEMS - APPLIED RESEARCH	18984	0	0	0	0	0	0	0
HH8 VOICE INTERACTIVE DEVICE	1630	1620	0	0	0	0	0	0
HH9 UNIVERSITY PROGRAM IN MOBILE ROBOTICS	0	1431	0	0	0	0	0	0
T21 21ST CENTURY TRUCK (T21)	9225	11343	0	0	0	0	0	0
T26 HYBRID ELECTRIC HMMWV	2878	0	0	0	0	0	0	0
T27 ADVANCED COATINGS RESEARCH	0	1048	0	0	0	0	0	0
T28 FASTENING AND JOINING RESEARCH	0	1239	0	0	0	0	0	0
T29 NBC AGENT WATER CONTAMINATION MONITORING	0	1142	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program researches, investigates and applies combat vehicle and automotive technologies that will improve survivability, mobility, sustainability, and maintainability of Army ground 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 protection without reliance on heavy passive armor. This challenge will be met using a layered approach, substituting long-range situational awareness, multi-spectral signature reduction, Active Protection (AP) systems and advanced lightweight armor for conventional armor. Project C05 focuses on this later survivability effort, designing a suite of protection components that, when installed and integrated, will give lightweight vehicles superior protection against Chemical Energy (CE) and Kinetic Energy (KE) threats with only one fourth the weight burden of the only conventional option - heavy armor. Goals are to provide lightweight structural armor at 20 lb/sq.ft. to defeat heavy machine gun threats and 60 lb/sq.ft. frontal armor to protect against more severe threats. In conjunction, Project H91 is developing unique CE & KE active protection countermeasures and vehicle-mounted sensor systems, required for AP cueing, targeting and intercepting threats, which are being characterized and tested. Project H91 also develops Hybrid electric and electric vehicle technologies, which are key enablers for achieving Future Combat Systems

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0602601A - Combat Vehicle and Automotive Technology**

(FCS) and Objective 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, electrothermal chemical (ETC) guns and electromagnetic (EM) armor. In the far 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. This program also advances technologies for critical power, propulsion and electric components, including energy storage, power distribution and pulse forming networks (PFNs). Components that will improve vehicle performance (e.g., active suspensions, wheel motors, regenerative brakes, vehicle electronics (VETRONICS), and track will be developed and matured. Project H91 provides components for improved mobility, including active suspensions, motors, generators, controllers, hybrid electric architectures, inverters and lightweight track. It also investigates and develops high temperature/power electronics, high energy density energy storage devices, and PFN elements (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. 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. This PE adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles, with oversight and coordination provided by the Joint Directors of Laboratories. The project is coordinated with the Marine Corps through the Naval Surface Warfare Center and with other ground vehicle developers within the Departments of Energy, Commerce, Transportation, and DARPA. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication of any similar effort within the Military Departments. Products of this program transition primarily to PE 0603005A for maturation and incorporation into platforms/vehicles. No Defense Emergency Response Funds were provided to this program. This program supports the Objective Force transition path of the Transformation Campaign Plan.

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February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	112957	55763	60728	59452
Current Budget (FY 2004/2005 PB)	109394	79952	80910	71108
Total Adjustments	-3563	24189	20182	11656
Congressional program reductions				
Congressional rescissions		-4455		
Congressional increases		30700		
Reprogrammings	-988	-458		
SBIR/STTR Transfer	-2575	-1598		
Adjustments to Budget Years			20182	11656

Change Summary Explanation:

Significant Changes:

FY04 (\$16262) & FY05 (\$11528) Funds increased to support Pulse Power for Electric Weapons and Hybrid Electric Vehicle efforts.

FY03 (\$30700) Congressional adds:

COMBATT, Project H77 (\$3500)

Next Generation Smart Truck, Project H77 (\$3400)

Combat Vehicle Mobility System, Project H91 (\$3400)

Military Wheeled Vehicle Electronic Architecture Integration (EAI), Project H91 (\$1700)

Voice Interactive Device, Project HH8 (\$1700)

University Program in mobile Robotics, Project HH9 (\$1500)

21st Century Truck, Project T21 (\$11900)

Advanced Coatings Research, Project T27 (\$1100)

Fastening & Joining Research, Project T28 (\$1300)

NBC Agent Water Contamination Monitoring/Remediation Technology, Project T29

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)**February 2003****BUDGET ACTIVITY
2 - Applied Research****PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive Technology**

(\$1200)

Projects with no R-2As:

(\$1700), Voice Interactive Device, Project HH8: The objective of this one-year Congressional Add is for enhancements to a voice-interactive software capability and interfaces that requires less individualized voice training and to embed this capability into a vehicle. No additional funding is required to complete this project.

(\$1500), University Program in mobile Robotics, HH9: The objective of this one-year Congressional Add is to integrate imaging and sensors into the ODIS robotic platform for security applications and the intelligent mobility programs. Demonstrate sensor and algorithm integration with platform and user including communications and data management. No additional funding is required to complete this project.

(\$11900), 21st Century Truck, T21: The objective of this one-year Congressional Add is to investigate and evaluate high power density engines, lightweight engine/components, high temperature engine materials, engine coatings, coolants and cooling systems computer controlled energy management systems, electric traction motors, electric generators, high power motor controllers, and advanced energy storage systems; integrated and test vehicle intelligence technologies that involve both information and control technology to improve fuel efficiency, driving efficiency, safety and quality of driving trucks. No additional funding is required to complete this project.

(\$1100), Advanced Coatings Research, T27: The objective of this one-year Congressional Add is to focus on identifying and proving out improved coatings and coating technologies for ground vehicles. The goal is to identify coatings that provide improved corrosion resistance and offer the potential for reduced operations and support costs. No additional funding is required to complete this project.

(\$1300), Fastening & Joining Research, T28: The objective of this one-year Congressional Add is to establish the Fastening and Joining Research Institute at Oakland University that will work towards making advances in joining components together. Emphasis will initially be placed on improving mechanical fastening methods to increase joint reliability, reduce costs and associated maintenance burdens that currently exist. No additional funding is required to complete this project.

(\$1200), NBC Agent Water Contamination Monitoring/Remediation Technology, T29: The objective of this one-year Congressional Add is to develop technologies that can detect and treat Nuclear, Chemical, and Biological (NBC) contamination in water. No additional funding is required to complete this project.

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A - Combat Vehicle and Automotive Technology					PROJECT C05			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
C05 ARMOR APPLIED RESEARCH	15362	18153	19972	15514	10738	10946	11194	11452	

A. Mission Description and Budget Item Justification: This project investigates, designs and tests armor component technologies and armor packaging to achieve lightweight, ballistically-superior integrated structures that will provide the last line of defense for Future Combat Systems (FCS) and Objective Force vehicles. The effort provides the analytical basis for understanding and predicting the effectiveness of various armor systems and examines the vehicle armor systems required to protect against collateral damage from debris from the AP system (debris protection). A major focus is on providing armor component technologies with reduced weight, reduced space claim and lower cost for protection against KE Projectiles, CE Warheads, Explosively Formed Penetrators (EFP) and blast fragments from mines. Goals are to provide base armor to defeat heavy machine guns and residual fragments from AP events at 20 lbs/sq.ft.; armor packages to defeat limited rocket propelled grenade (RPG) and medium caliber KE at 40 lbs/sq.ft.; and novel frontal armors to defeat heavier threats at 80 lb/sq.ft. for initial (block I) FCS. The latter will be reduced to 60 lb/sq.ft. for FCS block II. The armor technologies designed and fabricated in this project complement innovative non-armor survivability component techniques that are funded in project AH91. In addition, this project investigates low-burden solutions for the protection of tactical vehicles in war and operations-other-than-war, focusing on appliqué armor for small arms and land mine protection. International cooperative research in mine blast characterization and vehicle response is also conducted. The project is executed by TARDEC in collaboration with the ARL. Efforts are fully coordinated and complementary to work performed under PE 0602618A (Ballistic Technology) and PE 0602105A (Materials). No Defense Emergency Response Funds were provided to the project. This program supports the Objective Force transition path of the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive
Technology

PROJECT
C05

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Advanced Armor - In FY 02, completed quarter scale Smart Armor KE threat AP debris analysis. Completed trade study and evaluation of 2nd generation electromagnetic (EM) armor. In FY 03-04, provide Smart Armor solutions and model data for defeat of AP residual KE debris. Evaluate Smart Armor solutions that address medium caliber KE and CE threats that meet the intermediate weight efficiency goal of 80lbs/sq ft. Provide EM armor solutions for defeat of Chemical Energy (CE) weapons. Evaluate EM armor solutions that address large CE threats that meet the intermediate weight efficiency goal of 80lbs/sq ft. In FY04, complete 2nd generation EM armor component development.	15362	15379	2118	0
Countermine - In FY 03, evaluate lightweight ballistic solutions for mine blast protection and apply modeling and simulation tools. In FY04, demonstrate armor configurations, obtain improved mine blast data, and validate M&S. In FY05, complete testing and evaluation of FCS armor solutions for mine blast protection.	0	2774	2832	891
Structural Armors - In FY04, build vehicle quarter section ballistic targets and range test these fully integrated 3rd generation armor/structure designs against FCS Block II threats and demonstrate: armor/structural capability at FCS weights; integration of critical components; armor/structural reliability; and evaluation EM armor components for structural armor applications. Improve 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 platforms.	0	0	15022	14623
Totals	15362	18153	19972	15514

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A - Combat Vehicle and Automotive Technology					PROJECT H77			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H77 ADV AUTOMOTIVE TECH	40711	22509	24999	21760	16620	16564	16870	17274	

A. Mission Description and Budget Item Justification: This project funds the National Automotive Center (NAC), which leverages large commercial investments in automotive technology research and development. NAC initiates shared technology programs that focus on benefiting military ground vehicle systems. The component technologies being developed support the Army's current and future combat and tactical wheeled vehicle fleet. Improvements in the legacy force are expected to rely heavily on leveraging commercial technologies for advances in operational performance and cost. The NAC, a part of TARDEC, serves as a catalyst, linking industry, academia and government agencies for the development and exchange of automotive design and component technologies. The NAC executes collaborative research and development contracts and Cooperative Research and Development Agreements for two-way industry/government technology transfer that leverages commercial industry investment to support key Army automotive technology thrust areas. These areas include fuel efficiency, vehicle modernization, crew safety, maintenance, logistics improvement and manufacturing innovation. Efforts focus on improving the performance and endurance of ground vehicle fleets and reducing vehicle design, manufacturing, production, operating and support costs. Some activities of the NAC are supported by other government agencies via a Memorandum of Agreement (MOA). These linkages permit the NAC to consolidate the collective expertise of federal government departments such as Energy, Transportation, Commerce and other DoD agencies. The NAC also performs basic research in PE 0601104A, project H73 (National Automotive Center). A new initiative at the NAC is the Future Tactical Truck System (FTTS) program. The objective of this program is to incorporate a number of advanced technologies the Army, the NAC and commercial sector have been maturing in recent years into tactical support vehicles for the FCS and Objective Force, providing a number of FTTS Demonstrators that will be evaluated in a military unit field environment. Technical testing and User unit field demonstrations will determine their feasibility for transition to tactical vehicle development programs.

No Defense Emergency Response Funds were provided to the project. This system supports the Objective Force transition path of the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive Technology

PROJECT
H77

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Advanced Automotive Technology: In FY 02, evaluated Hybrid Electric (HE) M113 performance at Aberdeen Test Center (ATC); continued development and completed initial testing of hybrid electric HEMTT; completed testing the HE Light Armored Vehicle and Parallel HE drive; completed powertrain configuration study, which included modeling and simulation of 9 different solutions for the FMTV and initiated studies for the HMMWV and HEMTT; completed diagnostic solution for Family of Medium Tactical Vehicles (FMTV) with embedded Interactive Electronic Technical Manual and prognostics link. In FY 03, baseline COMBATT and Hybrid Electric COMBATT testing will be completed; updated Hybrid Electric design configuration and associated testing for the HEMTT will be completed; advanced development of the 8X8 to enhance power converter will proceed; will complete instrumentation of HEMTT ESP hydraulics with diagnostic sensors; demonstrate concept to HTV PM; test concept at ATC or equal; work with PM community to commonize A-kit and B-kit installations for embedded diagnostics on Brigade Combat Team vehicle fleet. In FY04, conduct extensive demonstrations and evaluations of subsystems and components which comprise hybrid electric propulsion systems in medium ground vehicles. FY05 demonstrate their synergistic effects when integrated with mission specific hardware/electronics, and offer these technologies/systems as candidates for inclusion in the Future Combat System.</p>	15941	15242	16091	15884
<p>Future Tactical Truck System (FTTS): In FY04, design Medium Support Vehicle variant and Utility variant, integrating selected advanced technologies such as high power density engines; hybrid electric propulsion; electric traction motors; advanced power distribution and control; advanced battery storage; independent and variable height suspension; semi-active/selectable damping suspension; advanced digital driver displays and controls; vehicle structure and cab designed for survivability and mine protection; and new methods and techniques for material handling. In FY05, fabricate prototype vehicles and conduct tests to verify performance characteristics.</p>	0	0	7918	4897
<p>Mobility: Vehicle Design - In FY03, complete requirements analysis and design for use of emerging commercially developed systems at 42VDC, 120 VAC. In FY04, develop baseline 42V power generation, energy storage devices, and smart power architecture components. In FY05, develop power distribution, power modules, and smart switching technologies.</p>	0	669	990	979
<p>COMBATT - In FY 02, this one-year Congressional Add performed performance/endurance testing of commercial vehicles converted to hybrid electric propulsion. In FY03, the objective of this one-year Congressional Add is to evaluate and mature technologies on commercial light truck platforms that enhance vehicle's performance while demonstrating the benefits of hybrid propulsion. No additional funds are required to complete this project.</p>	13441	3347	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive
Technology

PROJECT
H77

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Smart Truck - In FY02, this one-year Congressional Add completed adaptation of commercially available digital technology for improved operation and safety of Army trucks. In FY03, the objective of this one-year Congressional Add is to demonstrate emerging automotive/military technologies on commercially based platforms that can be used for homeland defense. No additional funds are required to complete this project.	3264	3251	0	0
Hydrogen PEM Fuel Cell Heavy Duty Vehicle - In FY 02, this one-year Congressional Add completed development of a hydrogen PEM fuel cell powered heavy duty vehicle for demonstration in California to quantify the overall reduction of emissions. No additional funds are required to complete this project.	4801	0	0	0
Advanced Virtual Environments - In FY 02, this one-year Congressional Add completed development of a suite of 3D graphic simulation tools and displays that will allow users to operate within a computer generated collaborative virtual environment on a real-time basis. No additional funds are required to complete this project.	1344	0	0	0
National Auto Center - In FY02, this one-year Congressional Add formulated advanced modeling and simulation strategies for the Army's vehicle fleet; validated advanced propulsion and mobility simulation models. No additional funds are required to complete this project.	1920	0	0	0
Totals	40711	22509	24999	21760

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A - Combat Vehicle and Automotive Technology					PROJECT H91			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H91 TANK & AUTOMOTIVE TECH	19698	20534	35939	33834	45375	44696	31913	22457	

A. Mission Description and Budget Item Justification: This project investigates, develops and tests innovative vehicle concepts, survivability and critical power, propulsion, and electronic component technologies for future combat vehicles. The project addresses: vehicle concepts; mobility; integrated survivability; mechanical (non-electronic) countermeasure technology; vehicle electronics (VETRONICS) and intra-vehicle digitization; military fuels and lubricants and; water recovery/purification. The vehicle concepts effort investigates novel vehicles, develops virtual prototypes, conducts trade studies, and makes performance predictions and analyses. Virtual prototyping provides early and frequent evaluation of vehicle systems and subsystems in a simulated environment, allowing more rapid and efficient integration, assessment and transfer of component technology. Virtual prototyping will also be used to evaluate lightweight advanced bridging technologies, which meets load and mobility requirements. The goal of the mobility effort is to advance technologies for prime power generation (engines), running gear (tracks and suspensions), hybrid electric systems (including intelligent power and energy management) and pulse power for all on-board electric powered systems, including Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), electro-magnetic armor, electro-thermo-chemical gun, environmental systems, soldier power recharging, and vehicle accessories. The Active Protection effort provides component technologies that contribute to an integrated vehicle survivability approach that also includes signature reduction, countermeasures, damage reduction, laser protection, and advanced lightweight structure and base armor improvements using revolutionary materials and process technology. Defeat of Kinetic Energy (KE) threats offers a substantial challenge due to size and speed of the threat. The goal of the AP against KE effort is to detect, track and defeat KE with a multi-purpose hard kill warhead. This work complements, but does not duplicate, work performed under the armor exploratory development project (C05). This project also assesses mechanical countermeasure technology components for lightweight, energy absorbing, mechanical systems to meet the Objective Force's Countermeasure Mobility requirement to breach obstacles in-stride. The goal of the VETRONICS effort is to investigate vehicle electronics based on adapting commercial electronic standards, architectures and components for combat vehicle battlefield unique requirements. Water recovery and purification are sustainability technologies focusing on reducing the logistics footprint by leveraging emerging technologies and the basic research being conducted by DARPA. One goal is to reduce water distribution requirements (estimated at 106 tons/day for UOA and projected to be 40% of the total daily sustainment requirement of the Objective Force) through the development of a distributed water production capability leveraging developments in two areas: 1) innovative purification of traditional water sources and 2) water recovery from non-traditional sources including exhaust and atmospheric humidity. Activities are closely coordinated with TRADOC's Mounted and Dismounted Battlespace Battle Labs, the Directorate of Combat Developments for Transportation, Quartermaster, Program Executive Office for Ground Combat and Support Systems, ARL; DARPA and the Red River Army Depot. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive
Technology

PROJECT
H91

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Advanced Distributed Simulation: In FY02, matured engineering level chassis models to evaluate mobility and dynamic stability of mobile manned and robotic vehicles. Developed FCS concepts and analyses and completed evaluation of the FCS industry team concepts through the IPT process. In FY03, mature physics based platform and terrain models for advanced manned and robotic ground vehicle subsystems. Complete baseline and validation experiments for moving vehicle operations. Provide FCS concepts, trade studies and performance predictions/input to performance predictions. In FY04, mature physics based mobility and durability models for advanced manned and robotic ground vehicle platforms and their associated complex urban, all-season terrain environment; make tire, snow and 3-D soil models run in real-time; develop models for ground contact with vehicle chassis and other implements. In FY05, mature the understanding of adverse effects of moving vehicle operations and promising passive and active mitigation strategies. Generate FCS Block II technology insertion concepts.	3000	1905	1586	1973
Hybrid/Electric Power: In FY03, develop and test high-power semi-conductor motor controllers for FCS. In FY04-05, develop advance silicon carbide for high voltage rectifier, converters, and motor drives for a more compact FCS Block II hybrid power management system for FCS. Evaluate advanced silicon and emerging wide bandgap power control for FCS block II and assess Li-Ion battery with improved performance (fire retarding and high retention) with power density of 2 kW/Kg.	0	500	1500	9600
Propulsion/Prime Power: In FY02, completed final 100 hour durability and performance demonstration of high output, low heat rejection compact 4-stroke diesel engine. In FY03, design/analysis/fabrication of running FCS test stand engines will be completed at 4.5 Net HP/cu-ft power density - Army will downselect to one engine. In FY04, full performance characteristics and 50 hour NATO durability testing will be demonstrated at 6 Net HP/cu-ft system power density. In FY05 selected engine will be performance and durability enhanced to achieve a 6 power density potential for integration into a complete propulsion package.	2750	3000	2000	1500

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive
Technology

PROJECT
H91

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
<p>Mobility/Drive - In FY02, completed fuel economy lab bench test evaluations of novel military fuels and lubricants; Petroleum Oil and Lubricants (POL) Quality Analyzer and Sensors device integration tested as a hand held unit; and performance analysis of heavy tactical vehicle concepts for mobility, survivability, transportability. In FY03, conduct fleet testing of novel fuels and lubricants; develop software to download POL Analyzer sensor data into AOAP database; and develop virtual prototypes of future light tactical vehicle configurations. In FY04, develop: improved Li-Ion battery with flame retardant electrolyte; high temperature, high frequency SiC switching devices; and in-hub and chassis high torque density motor concepts. In FY05, Investigate New Li-Ion battery electrode materials for higher power density; demonstrate and test high torque density chassis and in-hub motors; develop Cascade type SiC motor inverter and battery charger; and develop and test hybrid Si/SiC motor inverter.</p>	2822	1614	10962	8924
<p>Active Protection/Survivability - In FY 02, designed, tested and demonstrated radar sensor technology for Kinetic Energy threat detection and tracking. Integrated KE defeat capability algorithms in the Systems Integration Lab for trade studies. Designed man/machine interfaces and formats with soldiers to control active protection. In FY03, conduct dynamic CM range tests of potential CE & KE countermeasure configurations against multiple dynamic horizontal and overhead threats. In FY04, for countermeasure survivability technology, determine optimum ground pressure to trigger age affected legacy mines. In FY05, investigate lightweight material solutions capable of withstanding the local blast effect of legacy mines, using modeling and simulation.</p>	6236	1431	746	892
<p>Pulse Power Hybrid Electric - In FY04-05, investigate and develop high-energy film capacitors, switches and chargers for electro-thermo gun and electro-magnetic armor system power source. In FY04, develop: 1.2 J/cc capacitors; high voltage, di/dt Si, and SiC semiconductor switches; and 2.5 j/cc capacitor prototype at 1kV. In FY05, demonstrate: 13 kJ (1.2 j/cc) capacitors at 10 kV; SiC Thyristor at 10 kV; 2.5 J/cc capacitor at 10 kV; and hybrid Si/SiC PFN charger.</p>	0	0	12645	8971
<p>Crew Integration & Automation Testbed (CAT) - In FY02, evaluated cognitive decision aids to reduce crew workload on multi-mission capable vehicle systems such as FCS. The increase in FY03 covers evaluation of intra-vehicle networking using wireless technologies, hardware dynamic reconfiguration technology, adaptable software technology, and system health & usage monitoring technologies. Evaluate the usage of 3D audio systems for the control and situational awareness of robotic and dismantled unmanned system assets. In FY04, evaluate speech recognition technology for speaker independence, natural language and expanded control to unmanned systems while working high noise environment.</p>	1985	4084	1500	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602601A - Combat Vehicle and Automotive
Technology

PROJECT
H91

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Water recovery/purification - In FY02, demonstrated on-board water recovery from engine exhaust with HMMWV mounted water collection system achieving equivalent performance (0.5 to 0.6 gallons water/gallon fuel) with a 35% smaller heat exchanger than previously used. Transitioned MIOX (mix oxidant) electrolytic disinfection technology to PM Soldier and PM PAWS. In FY03, field demonstration of water recovery from exhaust prototype, with collection and purification system (of water from any source) integrated and mounted on a HMMWV. In FY04, demonstrate a water production prototype in a relevant environment that meets all the above requirements while reducing the operating (or price per gallon) costs by 20% and field assessment of purification of water from any source. In FY05, demonstrate feasibility of water recovery from atmospheric humidity with laboratory breadboard systems.	1925	3000	5000	1974
Calstart/Westart - This one-year Congressional Add demonstrated the hybrid electric component technologies in various vehicles used for public transportation and/or military purposes. No additional funding is required to complete this project.	980	0	0	0
Combat Vehicle Mobility System - The objective of this one-year Congressional Add is to develop component technology to improve mobility and survivability of the Army's ground vehicle systems. Making advances in the off-road mobility characteristics of wheeled vehicles to approach those of tracked vehicles is a major goal of the program. No additional funding is required to complete this project.	0	3334	0	0
Military Wheeled Vehicle Electronic Architecture Integration (EAI) - The objective of this one-year Congressional Add is to design and create an interface to serial databus architecture, such as J1939 and J1708, for legacy vehicles such as HMMWV, which will enable the vehicle platform to be equipped with critical capability like embedded diagnostics/prognostics. No additional funding is required to complete this project.	0	1666	0	0
Totals	19698	20534	35939	33834

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	60646	62458	53478	52392	54843	57366	53913	55240
H03 ROBOTICS TECHNOLOGY	23262	17393	18779	18625	18787	19106	19557	20006
H75 ELECTRIC GUN TECHNOLOGY	4837	4890	5412	5322	5100	5319	5458	5617
H80 BALLISTICS TECHNOLOGY	32547	40175	29287	28445	30956	32941	28898	29617

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 Objective Force and to allow US dominance in future conflicts across a full spectrum of threats in a global context. Project H75 focuses on pulsed power technologies for electric armaments which offer the potential to field leap-ahead capability in providing hypervelocity and hyperenergy launch well above the ability of the conventional cannon. It also includes work in hypervelocity penetrator effectiveness and electrothermal chemical (ETC) technology that will greatly increase anti-armor capabilities. Project H80 is focused on applied research in ballistics technology to enhance the lethality and survivability of future weapons. Focus areas included advanced solid propellants, launch and flight dynamics, weapons concepts for light forces, warheads and projectiles, armor and munition/target interactions. Project H03 focuses on applied research for advanced autonomous mobility technology for future land combat systems of the Objective Force. 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 060624 (Weapons and Munitions Technology), PE 0602705 (Electronics and Electronic Devices), PE 0602716 (Human Factors Engineering), PE 602782 (Command, Control, Communications Technology), PE 0603004 (Weapons and Munitions Advanced Technology), and PE 0603005 (Combat Vehicle Advanced Technology). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	60948	74094	65408	67445
Current Budget (FY 2004/2005 PB)	60646	62458	53478	52392
Total Adjustments	-302	-11636	-11930	-15053
Congressional program reductions		-6500		
Congressional rescissions		-3613		
Congressional increases				
Reprogrammings	849	-358		
SBIR/STTR Transfer	-1151	-1165		
Adjustments to Budget Years			-11930	-15053

Change Summary Explanation:

Significant Changes:

FY04/05 - Funds realigned to higher priority requirements.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

PROJECT
H03

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H03 ROBOTICS TECHNOLOGY	23262	17393	18779	18625	18787	19106	19557	20006

A. Mission Description and Budget Item Justification: This project advances autonomous mobility technology for the Future Combat Systems (FCS) and the Objective Force. It will investigate robotics technology critical to the development of future Army systems, including unmanned elements of the FCS, Objective Force Warrior (OFW) 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 will be focused towards 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 63005, and subsequent development of both semi-autonomous and near autonomous unmanned ground vehicles. 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. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

PROJECT
H03

Accomplishments/Planned Program

	FY 2002	FY 2003	FY 2004	FY 2005
- Execute industry/academic consortium (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. In FY02, devised approaches that will provide Unmanned Ground Vehicles (UGVs) the ability to classify & understand terrain, and to build the foundation for intelligent tactical behaviors. In FY03, advance technologies in terrain classification and mid-range perception and prove initial tactical behaviors and an improved understanding of human-machine interaction. In FY04, mature initial algorithmic structure to enable adaptive behaviors. In FY05, insert mature technologies onto testbed platforms to promote rapid transition of semi-autonomous capability to Objective Force systems.	7300	5602	7923	7926
- Enhance modeling and simulation infrastructure to enable development of semi-autonomous UGVs; devise and implement tools to enable rapid maturation of tactical behaviors. In FY02, devised One SAF based tools that permitted maturation of basic mapping behavior on a small robot. In FY03, mature common set of modeling tools for creation of tactical behaviors and for improving soldier-machine interfaces. In FY04, employ modeling tools to improve the soldier-machine interface. In FY05, employ modeling tools to implement tactical behaviors.	1296	915	1000	976
- Mature and integrate perception and control technology required for an intelligent robotic follower vehicle capable of achieving 35 MPH on-road and 20 MPH off-road mobility (chassis limited) with a time delay between passage of the manned leader vehicle and unmanned follower of up to 12 hours. In FY02, proved intelligent on and off-road follower capability for single vehicle using GPS generated waypoints. In FY03, transition technology to TACOM for implementation in Robotic Follower ATD.	6000	2744	0	0
- Mature perception, intelligent control, and man-machine interface technology required for a single soldier to manage the operation of multiple unmanned ground vehicles maneuvering near-autonomously through the battlefield. In FY02, devised improved perception capabilities for terrain reasoning and matured associate technology to enable adaptive tactical behaviors. In FY03, mature techniques of object classification. In FY04, implement fusion of multiple sensor modes for improved terrain reasoning. In FY05 mature technology required to show baseline adaptive tactical behaviors by unmanned ground vehicles.	3666	2643	5356	5333

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

**BUDGET ACTIVITY
2 - Applied Research**

**PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY**

**PROJECT
H03**

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- 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. In FY02, proved cross-country autonomous mobility in rolling terrain during field exercises in which a single soldier managed operation of up to 3 unmanned ground vehicles; proved initial baseline tactical behavior by unmanned ground vehicle. In FY03, advance maturity of autonomous mobility technology required to implement FCS Block I Armed Reconnaissance Vehicle. In FY04, incorporate improved perception and control technology to enable baseline cooperative behaviors. In FY05, prove baseline adaptive tactical behaviors.	5000	5489	4500	4390
Totals	23262	17393	18779	18625

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602618A - BALLISTICS TECHNOLOGY						PROJECT H75	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H75 ELECTRIC GUN TECHNOLOGY	4837	4890	5412	5322	5100	5319	5458	5617

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), more lethal, yet compact main armament systems capable of defeating protection levels greatly in excess of current values are required. 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, greatly above 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 pulsed power for electromagnetic (EM) launches. This project funds a contractual effort to devise and evaluate an efficient pulsed power technology for electromagnetic (EM) launch. The goal is to provide pulsed power technology (rotating machines) with energy density of ten Joules per gram (J/g) and to identify a clear potential for growth required for future combat systems, expected to be greater than fifteen J/g. Through FY02, this project funded applied research for the Army Electrothermal Chemical (ETC) gun technology program, applying ETC technology to potential armament systems for the Future Combat System (FCS) in both medium and large caliber with the FY02 goal of increasing muzzle energy by 25%. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

Accomplishments/Planned Program

	FY 2002	FY 2003	FY 2004	FY 2005
- Proved required muzzle kinetic energy with ETC in a surrogate FCS Multi-Role Armament System and identified candidate ETC propellants and validated improved mechanical properties/vulnerability characteristics; transitioned technology to the Armaments Research Development and Engineering Center for further development.	1000	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

PROJECT
H75

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Mature and prove compact pulsed power system for EM guns. In FY02, designed pulsed alternator and conducted component tests to reduce technical risk; produced advanced high power switches for converters for EM pulsed power system; designed and evaluated controller for multi-phase, multi-pole operation of pulsed power machine; and used EM gun component technology models for conducting system level simulations. In FY03, finalize design of EM gun system and begin fabrication of full-scale critical pulsed power components. In FY04, complete fabrication of critical pulsed power components and validate integrity. In FY05, complete fabrication of thermal management, EM shielding, and auxiliary systems.	2437	3950	4833	4912
- Establish and mature technologies for efficient, lightweight EM guns and projectiles to enable revolutionary lethality for Objective Force platforms. In FY02, conducted experiments on laboratory launcher uncovering and solving rail life issues; conducted experiments on field worthy launcher test sections uncovering fabrication challenges; and evaluated launch package designs for integrity and transition resistance. In FY03, solve engineering challenges, build field worthy 60mm launcher, and fire an integrated launch package with a steel, monolithic penetrator. In FY04, conduct firings from field worthy launcher to full design energy and complete maturation of integrated launch package for a KE projectile. In FY05, fire an integrated launch package from field worthy launcher.	1400	940	579	410
Totals	4837	4890	5412	5322

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602618A - BALLISTICS TECHNOLOGY						PROJECT H80	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H80 BALLISTICS TECHNOLOGY	32547	40175	29287	28445	30956	32941	28898	29617

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 Objective Force. The challenge is to insure 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 (KEAP) 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

PROJECT
H80

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Optimize advanced lightweight structural, ceramic, and electromagnetic armor technologies that meet FCS threshold capability for transition to FCS vehicle designers, and mature ballistic shock and mineblast mitigation technologies to enable revolutionary survivability for FCS and Objective Force Platforms. In FY02, designed and evaluated second-generation lightweight frontal and structural armor technologies that were provided as baseline armor configurations in support of FCS vehicle trade studies, and applied modeling and simulation tools for improved performance of FCS armors and survivability concepts. In FY03, transition lightweight armor technologies to TARDEC for integration into FCS. In FY04, evaluate improved objective armor technologies to include electromagnetic and enhanced ceramic armor that improve upon the performance of the transitioned threshold armor and evolve ballistic shock and mineblast mitigation technologies. In FY05, optimize armor packaging and transition improved hybrid armor technologies to FCS vehicle designers and prove capability of ballistic shock and mineblast mitigation technologies.</p>	10640	11592	10295	7469
<p>- Mature multi-role 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 Objective Force lethality. In FY02, devised and applied physics-based models for missile divert and interior ballistic launch, coupled with weapons effectiveness analyses to evaluate concepts for dynamic retargeting. In FY03, Optimize multi-disciplinary design tools and fully characterize high-g GN&C components. In FY04, Prove validated multidisciplinary models for precision gun-fired munitions, couple with system effectiveness models, and prove gun launch as well as deployment of gun launched dynamic retargeting assets. In FY05, transition fully coupled suite of models and validated dynamic retargeting technology to munitions development community.</p>	4364	4509	4586	4493

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

PROJECT
H80

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- 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/Objective Force gun/missile systems and warheads. In FY02, characterized performance of high energy/acceptable vulnerability propellant formulation (GEN II) and transitioned to ARDEC as potential candidate for implementation in advanced multi-role armament for FCS. In FY03, evaluate novel/nanostructural IHEM concepts. In FY04, characterize candidate novel insensitive high-energy materials and assess concepts for exploiting managed energy release for FCS/Objective Force gun/missile systems and warheads. In FY05, provide matrix of novel IHEM propellant and explosives for specific Objective Force applications.	2736	2608	2966	3084
- Mature counter-munition and sensor technologies effective for active protection defeat of kinetic energy (KE) munitions, which is critical to enable revolutionary survivability of FCS and Objective Force platforms. In FY02, down-selected blast-deflect KE counter-munition defeat and sensor suite configurations for transition to full-scale KEAP breadboard experiment. In FY03, combine blast deflect KE counter-munition and sensor suite in breadboard KE active protection experiment and evaluate to optimize performance against KE threat. In FY04, prove effectiveness of blast-deflect KEAP system consistent with Tank Automotive and Armaments Command Full Spectrum Active Protection (FSAP) system requirements. In FY05, optimize blast-deflect countermeasure design against both KE and CE threats, and transition to TARDEC FSAP development program.	4322	3935	1825	1789
- Mature multi-role 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 Objective force lethality. In FY02, improved fidelity of predictive models and performed optimization studies of selected gun and missile KE/Warhead lethal mechanism concepts. In FY03, perform breadboard experiment of selected KE/warhead lethal mechanism components and initiate transition to ARDEC and AMRDEC for integration into FCS multi-role munitions. In FY04, identify preferred options to reduce energy/mass required to defeat emerging threats and to provide multi-purpose capabilities for revolutionary Objective 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 Objective Force munitions developers.	3125	3290	3536	3621

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602618A - BALLISTICS TECHNOLOGY

PROJECT
H80

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Devise state-of-the-art survivability/lethality/vulnerability methodologies to dynamically model the interaction of conventional ballistic threats versus FCS and Objective Force System of Systems. In FY02, characterized the ballistic-induced deformation of select composite armors and structural materials to predict the penetration and blast survivability of the FCS and devised engineering-based predictions of crew acceleration and detonation/explosive reactions of stowed ammunition for Objective Force ground vehicles impacted by moderately overmatching ballistic munitions. In FY03, implement first generation advanced armor penetration algorithms in survivability/lethality analysis codes for sophisticated multi-layering protection schemes employed for multi-hit protection of U.S. Army ground systems and the Objective Force and provide the survivability/lethality analysis code framework to dynamically model the interaction of an incoming conventional ballistic threat versus a ground combat vehicle equipped with an active protection system. In FY04, devise models for various damage mechanisms such as fuel fire and ammunition reaction as well as penetration and blast damage to new/novel materials. In FY05, experimentally validate models.	6100	5543	6079	6200
- Mature and prove advanced pulse power componentry critical to enable implementation of revolutionary electromagnetic armor technology onto FCS platforms. In FY03, optimize logic and control system to minimize space and weight for FCS system. In FY05, prove advanced pulse power componentry necessary to enhance FCS survivability. Program executed by ARL in coordination with TARDEC.	1260	8698	0	1789
Totals	32547	40175	29287	28445

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
**0602622A - Chemical, Smoke and Equipment Defeating
 Technology**

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	6079	15643	3540	3553	3713	3742	3830	3933
552 SMOKE/NOVEL EFFECT MUN	3190	3395	3540	3553	3713	3742	3830	3933
BA1 BIOTECHNOLOGY	1931	0	0	0	0	0	0	0
BA3 ADVANCED SENSORS AND OBSCURANTS	0	1906	0	0	0	0	0	0
BA4 METALLIC PARTICLES IN DEFENSE APPLICATIONS (MPDA)	0	1431	0	0	0	0	0	0
BA5 SYSTEMS FOR SAMPLING AND DETECTING BIOAEROSOLS	0	4335	0	0	0	0	0	0
BA6 VAPOROUS HYDROGEN PEROXIDE TECHNOLOGY	0	4576	0	0	0	0	0	0
CA1 THERMOBARIC WARHEAD DEVELOPMENT	958	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The goal of this Program Element (PE) is to investigate and develop smoke and obscurant technologies to increase personnel and platform survivability. The PE funds applied research in materials science and dissemination technologies to counter enemy weapon target acquisition systems and to provide the ability to degrade enemy surveillance capability. The material and dissemination systems will be designed to be safe and environmentally acceptable. Work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This PE contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD. This work supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided for this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
**0602622A - Chemical, Smoke and Equipment Defeating
 Technology**

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	6529	3675	3940	3904
Current Budget (FY 2004/2005 PB)	6079	15643	3540	3553
Total Adjustments	-450	11968	-400	-351
Congressional program reductions				
Congressional rescissions		-378		
Congressional increases		12850		
Reprogrammings	-303	-89		
SBIR/STTR Transfer	-147	-415		
Adjustments to Budget Years			-400	-351

FY03 Congressional Adds:

Advanced Sensors and Obscurants, Project BA3 (\$2000); Systems for Sampling and Detecting Bioaerosols, Project BA5, (\$4550); Vaporous Hydrogen Peroxide Technology, Project BA6, (\$4800); Metallic Particles in Defense Applications (MPDA) Obscurant Smokes, Project BA4 (\$1500)

Projects with No R-2A:

-\$1906, Advanced Sensors and Obscurants, Project BA3, is the second year of a Congressional add placed in PE0602120A in FY02. The objective of this add is to research new techniques in sensors and obscurant materials. No additional funding is required to complete this project.

(\$1431), Metallic Particles in Defense Applications, Project BA4: The objective of this one year Congressional add is to research metallic materials for obscurant applications. No additional funding is needed to complete this project.

(\$4335), Systems for Sampling and Detecting Bioaerosols, Project BA5: The objective of this one year Congressional add is to develop new types of bioaerosol detection systems utilizing advancements in air sampling, biological and chemical speciation, and optics. No additional funding is required to complete this project.

(\$4576), Vaporous Hydrogen Peroxide Technology, Project BA6: The objective of this one year Congressional add is to research vaporous hydrogen peroxide technology for decontamination applications. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602622A - Chemical, Smoke and Equipment Defeating Technology					PROJECT 552			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
552 SMOKE/NOVEL EFFECT MUN	3190	3395	3540	3553	3713	3742	3830	3933	

A. Mission Description and Budget Item Justification: Project 552 researches and investigates smoke and obscurant technologies to increase personnel/platform survivability and to provide the ability to degrade enemy surveillance sensor capability. Improved multi-spectral smokes/obscurants are explored to enhance survivability by providing effective, affordable, and efficient screening of deployed forces from threat force surveillance sensors and effective defeat of target acquisition devices, missile guidance, and directed energy weapons. These systems will be designed to be safe and environmentally acceptable. Modeling and simulation (M&S) tools will be investigated to predict performance and analyze strategic use of obscurants on the battlefield. A major effort, Advanced Infrared (IR) Obscurants, is focused on increasing current IR obscurant performance by 4X (reducing logistics by >50%), for use in IR smoke pots, grenades and projected munitions. Other efforts within this project research obscurant enabling technology for Distant Smoke, Smoke Pot, and other obscurant capabilities. These efforts advance dissemination, delivery, M&S and vehicle protection technology to expand survivability options through increased standoff and threat protection. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided for this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602622A - Chemical, Smoke and Equipment
Defeating Technology

PROJECT
552

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Advanced IR Obscurants In FY02, investigated and modeled IR sensor defeat mechanisms. Determined if commercial processes exist, or can be modified, to produce candidate countermeasure materials; investigated obscurant performance measurement technique addressing unique aspects of nano-particles; created test quantities of candidate materials for initial evaluation. In FY03, evaluate performance of candidate materials and develop laboratory method for evaluating its performance as an aerosol. In FY04, demonstrate a new IR obscurant screening material and laboratory method to evaluate performance as an aerosol; investigate the applications of this advanced obscurant material in simulations to determine the increase of survivability for the soldier. In FY05, identify dissemination techniques for new IR materials; develop concepts for prototype systems for use in grenades, artillery rounds, etc. and conduct trade-off analyses.</p>	2000	2248	2437	2350
<p>Obscurant Enabling Technology for Distant Smoke, Smoke Pot, and other obscurant capabilities In FY02, researched Distant Smoke concepts using robotics for remote delivery; assessed performance of promising smoke pot dissemination technologies; upgraded modeling & simulation tools for vehicle protection. In FY03, investigate a remotely piloted smoke generator technology for Distant Smoke; conduct propellant dissemination experiments for self protection applications. In FY04-05, conduct modeling and simulation case studies to predict and analyze performance of Distant Smoke, Smoke Pot, and other obscurant applications; perform field experiments on obscuration/dissemination technologies to optimize vehicle protection.</p>	1190	1147	1103	1203
Totals	3190	3395	3540	3553

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602623A - JOINT SERVICE SMALL ARMS PROGRAM					PROJECT H21			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H21 JT SVC SA PROG (JSSAP)	5088	5468	5835	5979	6173	6463	6606	6760	

A. Mission Description and Budget Item Justification: Investigates and researches key individual and crew-served weapon technologies that will enable the Army Transformation to the Objective Force by enhancing the fighting capabilities and survivability of dismounted battlefield personnel of the Services. Funded efforts include component technologies for: the Objective Crew-Served Weapon (OCSW); the Objective Individual Combat Weapon (OICW) System Enhancements; the Lightweight Machine Guns and Ammunition (LMGA); Light Fighter Lethality; and Advanced Medium Machine Gun Technology. OCSW provides the next generation crew-served weapon with improved combat effectiveness, including bursting munitions technology to provide 500%+ increase in probability of target incapacitation at extended range (to 2000m) with the capability to hit protected personnel targets in defilade (obscured or non-visible), and reduced weight over weapons it replaces. The OCSW is designed to replace selected M2 machine guns and MK19 grenade machine guns. The OICW System Enhancement efforts develop lethality-enhancing and cost/weight-reducing technologies for OICW. The LMGA, complementing both the highly lethal OICW & OCSW will offer significantly reduced weight over the currently fielded M249 SAW 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 current levels of performance. Light Fighter Lethality effort provides smart munition based weapon system technologies that will reduce dramatically warfighter system weight (25-50% weapon weight reduction), provide near 100% lethality, and maximize operational utility and survivability for the Objective Force. The Advanced Medium Machine Gun Technology effort provides technologies for a lighter, more effective and versatile replacement for current 7.62mm medium machine guns. The technology enhancement efforts of this PE will assure that the Objective Family of Small Arms (OFSA), the next generation of small arms weapons systems, continues to overmatch the evolving threat and addresses the needs of the Objective Force. All Joint Service Small Arms Program (JSSAP) efforts are based upon the Joint Service Small Arms Master Plan (JSSAMP), Mission Needs Statements and Operational Requirements Documents of the Services. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program is primarily managed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey. 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 Soldier, Project Manager Soldier Weapons, Product Manager (PM) Small Arms, PM OICW, USMC Director Ground Weapons and US Special Operations Command (SOCOM). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

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

PROJECT
H21

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
-OCSW: In FY02, demonstrated target acquisition/fire control system ranging and ballistic solution calculation; demonstrated muzzle velocity correction capability; completed plan and preparations for OCSW Advanced Technology Demonstration technical and troop testing; In FY03, refine fuze design; evaluate explosive train; conduct environmental testing of weapon; extend limits of man-rated firing; fabricate/upgrade weapons; complete contractual reporting requirements.	3166	1351	0	0
-OICW: In FY03, complete Micro Scale Firetrain formulation and transfer charge design for gun launched micro electro-mechanical system based safe and arming evaluation.	0	1000	0	0
LMGA: In FY03, investigate weapon component technologies and work with Objective Force Warrior Lead Technology Integrators to determine needs. Quantify operational and human enhancements for individual soldiers through modeling, simulation and analyses of applicable concepts. Assess alternate case ammunition concepts as enabling technologies for a lightweight family of weapons and for lightweight 5.56 ammunition. In FY04, evaluate and mature lightweight material technologies for small arms application. Design and assess mechanisms to reduce weight and provide component commonality across a family of weapons. Assess potential of placing traditional weapon function on the soldier and of placing other soldier system controls on the weapon. In FY05, downselect to final weapon development design.	0	3117	4835	4979
-Light Fighter Lethality: In FY02, completed design and verification of critical sub-system designs through constructive simulation of individual and force on force empirical performance, leading to final design selection and fabrication of test hardware.	1922	0	0	0
-Future Combat System (FCS): In FY04, provide support to FCS through Objective Force Warrior program. In FY05 develop plans for integration of individual soldier lethality with FCS program.	0	0	1000	1000
Totals	5088	5468	5835	5979

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

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

PROJECT
H21

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	5560	5812	5891	6208
Current Budget (FY 2004/2005 PB)	5088	5468	5835	5979
Total Adjustments	-472	-344	-56	-229
Congressional program reductions				
Congressional rescissions		-178		
Congressional increases				
Reprogrammings	-346	-31		
SBIR/STTR Transfer	-126	-135		
Adjustments to Budget Years			-56	-229

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	62914	72504	39485	45598	44192	41846	42580	42596
H18 ARTY & CBT SPT TECH	15796	16183	12256	14745	14225	15379	15642	16020
H19 CLOSE COMBAT WEAPONRY	9975	9729	6846	6729	11527	12339	12558	6486
H1A WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	0	2382	0	0	0	0	0	0
H28 MUNITIONS TECHNOLOGY	24766	23574	20383	24124	18440	14128	14380	20090
WA2 GREEN ARMAMENTS TECHNOLOGY	4989	5337	0	0	0	0	0	0
WA3 CORROSION MEASUREMENT AND CONTROL	4125	3241	0	0	0	0	0	0
WA4 ARMAMENT SYSTEMS NETWORK IA CENTER	3263	3336	0	0	0	0	0	0
WA5 HOMELAND DEFENSE TECHNOLOGIES	0	4670	0	0	0	0	0	0
WA6 NANOTECHNOLOGY CONSORTIUM	0	953	0	0	0	0	0	0
WA7 PUBLIC-PRIVATE PARTNERSHIP, NON-MUNITIONS	0	1668	0	0	0	0	0	0
WA8 SEAMLESS DATA DISPLAY	0	1431	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This Program Element (PE) researches improved weapon and munitions technologies to enable combat overmatch for the Objective Force. Efforts are focused on meeting requirements of the Future Combat Systems (FCS). The program funds research that will result in increased system lethality and survivability with the potential for better affordability, lower weight and reduced size. The FCS Multi-Role Armament and Ammunition System (MRAAS) Advanced Technology Demonstration (ATD) will provide the basis for a direct and indirect fire system for FCS designed to exceed the lethality of the Abrams main battle tank. At lower turret elevation positions the weapon system will provide direct capabilities, while at higher elevation positions, up to 55 degrees (based on chassis configuration), it will achieve indirect fire capabilities. It uses advanced materials, advanced recoil techniques, and Electrothermal-Chemical (ETC) propulsion to overcome the challenges of creating a smaller, lighter armament system with lethality equaling or exceeding that of current systems. The current government baseline for FCS Multi-Role Ammunition is a three-cartridge suite that provides overwhelming lethality at ranges up to 50 km (based on chassis configuration), with increased weapon delivery accuracy. Specific efforts in explosives, propellants, fuzing, composite structures, miniaturized seekers and warhead technology are the pacing technologies in support of the ammunition suite. Multiple Effects Warhead Technology researches new warhead technologies for smaller, more lethal chemical energy warheads. Advanced Sensors for Smart Munitions will enhance current smart sensors for use in the ammunition suite.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology

Responsive Accurate Mission Module (RAMM) provides technologies for an advanced mortar for FCS manned or tele-operated ground vehicles. The PE also funds the development of modeling and analytic codes for thermal analysis and high impetus, low flame temperature propellants to reduce wear on gun tubes (which degrades accuracy and increases the system cost); advanced armament fire control; advanced laser radar/infrared (LADAR/IR) sensor technology to enhance performance of smart munitions; technology advances in acoustic sensors; advanced wear and erosion resistant barrel coatings to increase service life and provide an environmentally friendly barrel coating process; thermal management of high performance, high rate of fire, large caliber guns; ways to make artillery systems more flexible and deployable through range extension and weight reduction technologies; and smart materials to improve accuracy and reduce operational and support (O&S) costs. Beginning in FY 06, this PE will research multi-mode sensor and Automatic Target Recognition technologies for future smart munitions as well as microelectronic fuzing technology. The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. The U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey primarily manages this program. No Defense Emergency Response Funds have been provided to this program.

Work in this PE is related to, and fully coordinated with, efforts in PE 0602618A (Ballistics Technology) and PE 0602623A (Joint Service Small Arms Program (JSSAP)), and its technologies typically transition to PE 0603004A (Weapons and Munitions Advanced Technology) and PE 0603802A (Weapons and Munitions Advanced Development). This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	65197	38090	37961	42422
Current Budget (FY 2004/2005 PB)	62914	72504	39485	45598
Total Adjustments	-2283	34414	1524	3176
Congressional program reductions				
Congressional rescissions		-2876		
Congressional increases		39350		
Reprogrammings	-930	-417		
SBIR/STTR Transfer	-1353	-1643		
Adjustments to Budget Years			1524	3176

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)**February 2003****BUDGET ACTIVITY
2 - Applied Research****PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology**

Change Summary Explanation:

Significant Changes:

FY04 - (\$3813) Funds increased to support the Multiple Effects Warhead Technology effort.

FY03 Congressional Adds:

Phyto-Extraction Technology, Project H1A (\$2500); Public Private Partnership, Non-Munitions, Project WA7 (\$1750); Applied Research Integration, Project H18 (\$1400); Homeland Defense Technologies, Project WA5 (\$4900); Green Armaments Technology, Project WA2 (\$5600); Nano Technology in SmartCoatings Partnership, Project H18 (\$1750); Nano Technology for Smart Munitions, Project H18 (\$1400); Generation-2 Warhead Development (X-caliber) Explosively Formed Penetrators, Project H28 (\$1400); Seamless Data Display, Project WA8 (\$1500); Single Crystal Tungsten Alloy Penetrators, Project H28 (\$3000); Alloy Tungsten (LA-T) Armor Piercing Ammunition, Project H28 (\$4250); Armament Systems Network IA Center, Project WA4 (\$3500); Corrosion Measurement & Control Project, Project WA3 (\$3400); M795 extended range, high explosive baseburner projectile, Project H28 (\$2000); Nanotechnology Consortium, Project WA6 (\$1000)

Projects with no R-2A:

(\$2465) Phyto-Extraction Technology, Project H1A: The objective of this one year Congressional Add is to conduct applied research to develop phyto-extraction decontamination technology. No additional funds are required to complete this project.

(\$1726) Public Private Partnership, Non-Munitions, Project WA7: The objective of this one year Congressional Add is to fund applied research in partnership with industry and non-governmental public organizations to develop non-munitions technologies. No additional funds are required to complete this project.

(\$4832) Homeland Defense Technologies, Project WA5: The objective of this one year Congressional Add is to conduct applied research supporting the development of technologies supporting Homeland Defense. No additional funds are required to complete this project.

(\$5522) Green Armaments Technology, Project WA2: The objective of this one year Congressional Add is to research and develop environmentally friendly armaments technologies. No additional funds are required to complete this project.

(\$1480) Seamless Data Display, Project WA8: The objective of this one year Congressional Add is to research data display technologies for weapons systems. No additional funds are required to complete this project.

(\$3451) Armament Systems Network IA Center, Project WA4: The objective of this one year Congressional Add is to research integration and analysis technologies to support armament systems networks. No additional funds are required to complete this project.

(\$3353) Corrosion Measurement & Control Project, Project WA3: The objective of this one year Congressional Add is to research corrosion measurement technologies that control and mitigate sources of corrosion. No additional funds are required to complete this project.

(\$986) Nanotechnology Consortium, Project WA6: The objective of this one year Congressional Add is to conduct applied research to identify nanotechnology solutions for the warfighter. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602624A - Weapons and Munitions Technology						PROJECT H18	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H18 ARTY & CBT SPT TECH	15796	16183	12256	14745	14225	15379	15642	16020

A. Mission Description and Budget Item Justification: This project focuses on applied research of technologies for multi-role cannon, mortar weapon, smart cargo projectile, fire control and combat support systems in support of FCS and the Objective Force. Specific efforts include FCS MRAAS; RAMM; QuickLook; Advanced Sensors for Smart Munitions; and Advanced Acoustic/Seismic Systems. Recoil management and lightweight materials technologies are being investigated to create a more lethal, lightweight FCS Multi-Role Armament, utilizing ETC propulsion. Also being pursued is the corresponding FCS Multi-Role Ammunition suite, which includes technologies for achieving both revolutionary fire support lethality and precision point target defeat at extended ranges in lighter and smaller configurations. The RAMM lightweight mortar concept will be developed to a maturity level suitable for insertion into FCS. QuickLook will provide the brigade commander with real time target imagery, target coordinates, and battle damage assessment (BDA). This system will utilize an artillery launched loitering munition that flies out to a maximum range of 50 km, acquires the target and transmits targeting information, such as video and/or Global Positioning System (GPS) coordinates, back to the tactical operations center via a wireless link. Advanced acoustic sensors will be investigated for providing non-line of sight target cueing for a variety of weapons platforms. Technologies for reducing artillery target location error and for providing to fire direction centers real time targeting and battle damage assessment data are being matured to support information dominance strategies for FCS. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
-RAAM: In FY02, finalized the hardware design of the mortar system and autoloader/magazine. In FY03, complete generation of system simulation models; establish a virtual battlefield model and conduct a performance analysis of the RAMM mortar system. At the end of FY 03, designs and models developed will be transitioned to support the maturation and demonstration of RAMM under PE0603004A.	802	3977	984	0
- Advanced Sensors for Smart Munitions: In FY02, concluded system trade-off studies and compiled baseline algorithm code; finalized design and began fabrication of tactical sensor hardware for captive flight test. In FY03, fabricate smart sensor component hardware and perform captive flight test; conclude sensor suite packaging analysis for smart munitions. This effort will transition to the MRAAS Program for use in the ATD described in PE0603004A	1576	1790	0	0

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology

PROJECT
H18

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Advanced Acoustic/Seismic Sensors: In FY02, incorporated advanced detection, classification and tracking algorithms/software into acoustic sensor testbeds, then validated the modeling predictions with empirical sensor performance improvements. In FY03, evaluate integrated acoustic cuers on Strikers for AN/TPQ-36/37 (Fire Finder Radar) and transmit location messages to the fire director center; integrate acoustic and seismic modeling capabilities; implement advanced acoustic sensor networks. In FY04, integrate the acoustic & seismic propagation and sensor system model on a developmental platform; conduct an initial evaluation of a sensor emplacement tactical decision aid for optimum system performance.	962	1989	1341	0
-Quicklook: In FY02, conducted an evaluation demonstration of the QuickLook system, detecting and locating targets in real-time, using battlefield imagery and GPS coordinates.	1800	0	0	0
- MRAAS: In FY02, completed detailed design of ETC propulsion and turreted armament system; conducted limited gun testing of cartridge case and seals with ETC ignition and kinetic energy (KE) composite sabot; continued Smart Suite design tradeoffs and laboratory demos of shaped charge (SC) and explosively formed penetrator (EFP) warheads. In FY03, fabricate smart cargo projectile test hardware for high-G testing and full-scale wind tunnel testing; conduct maneuverability analysis and preliminary guidance and control design for laboratory testing; complete fabrication of hardware and conduct breadboard demonstration of a Multi-Purpose Extended Range Munition (MP-ERM) air frame projectile; fabricate hardware for maneuver mechanism and guidance and control airgun tests. In FY04, complete system integration laboratory demo of fire control functionality; complete functional demo's of launcher and autoloader prototypes; initiate turret manufacturing/integration. In FY05, conduct form and fit testing on hardstand followed by turret system checkout (turret slew, gun elevation, and autoloader feed rate).	6287	4045	9931	14745
- This one year Congressional add for Smart Coatings, will complete development of coatings for Army materiel that are self-healing and have advanced attributes such as providing camouflage. No additional funding is required to complete this project.	971	1686	0	0
- This one year Congressional add for Army Center of Excellence in Acoustics will complete development of acoustic sensor systems for FCS applications. No additional funding is required to complete this project.	3398	0	0	0
-This one year Congressional add for Applied Research Integration will investigate new armament and fire control technologies for future Army systems. Lethality will be increased with lighter, more effective systems. Technologies to be explored include warheads, fire control, fuzing, smart munitions/algorithms, directed energy, etc	0	1348	0	0
-This one year Congressional add for Nanotechnology for Smart Munitions develop nanoparticle and devices for integration into smart munitions. This includes materials and transducer devices.	0	1348	0	0

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2 - Applied Research

PE NUMBER AND TITLE
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PROJECT
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Accomplishments/Planned Program (continued)

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Totals	15796	16183	12256	14745

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PROJECT
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COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H19 CLOSE COMBAT WEAPONRY	9975	9729	6846	6729	11527	12339	12558	6486

A. Mission Description and Budget Item Justification: This project focuses on applied research of technology for maneuver and fire support cannon armament systems in support of FCS and the Objective Force. The project funds research in technologies that will result in significantly greater lethality with more accurate delivery, significantly reducing logistics footprint while reducing life cycle costs for ground and air 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. Principal efforts support the ammunition suite for the FCS MRAAS and MP-ERM for rapid extended range defeat of high value targets out to 8km+, expanding the maneuver commander's battle area 7-fold. This project funds modeling and simulation of advanced armament systems leading to application for FCS. Cannon design technologies include: recoil mitigation techniques for use of large caliber cannons on lightweight (less than 20 ton) vehicles and a novel chamber configuration, leading to overall compact armament system configurations. Advanced barrel coating technology, utilizing cylindrical magnetron sputtering (CMS) of refractory alloys, is being pursued to provide extended barrel life for tanks, artillery and FCS cannon systems, with potential to provide an environmentally friendly process as a future replacement for chrome plating. This PE will develop advanced multi-mode fuzing technologies including some lower cost, self-destruct technologies for submunitions that could reduce unexploded ordnance on the battlefield and provide low cost electronic safe and arm devices for single and future multi-mode warheads. The project also develops extended range munitions and alternative mechanisms to defeat advanced armor systems. Both hardware and analytical tools will be developed and used to assess system performance, identify problem areas and develop solutions. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
-MRAAS: In FY02, completed base design of lightweight, low impulse Multi-Role Cannon for FCS; validated FCS Kinetic Energy (KE) Munition launch package (novel penetrator with composite sabot) function from FCS ammo configuration; conducted electronic safe and arm fuzing initiation accuracy for multi-point detonations. In FY03, conduct initial fabrication of lightweight cannon, autoloader, fire control, ETC propulsion and turreted armament system; conduct initial system component demonstration; conduct high-G tests of beyond line of sight (BLOS) projectile sensor components; initiate optimization of multimode warheads in prototype projectile designs. In FY04, conduct beyond line of sight (BLOS) projectile airframe structural integrity demonstration; demo composite sabot with integration of novel penetrator against armor; complete non line of sight (NLOS) projectile design; conduct BLOS projectile warhead demo vs. armor targets; continue seeker high-G tests . In FY05, conduct firing demonstration of ETC) propulsion for KE round ; demo composite sabot with integration of novel penetrator agaisnt armor; conduct BLOS projectile flight test; conduct BLOS projectile warhead demo vs. multiple target types. Also in FY05, begin conceptualization of next generation direct fire projectiles to defeat future threat targets.	4000	6048	3211	5000
MRM: Reduced size of critical sensor/seeker and electronic subsystem components; conduct sub-system high-g testing.	3730	0	0	0
Advanced Light Armament for Combat Vehicles: Completed medium caliber novel KE penetrator target effects evaluation; down select to best technical approach.	500	0	0	0
-Agile Target Effects: In FY02, demonstrated synergy of directed energy effects in laboratory; established baseline effects of an acoustic/light direct energy (dazzler) munition. In FY03, identify Agile Target Effects laser and microwave sources and demonstrate reduction of input power to defeat selected targets; enhance dazzler energetic material with nano-particles. In FY04, integrate laser and microwave sources into brassboard Agile Target Effects weapon system and demonstrate effectiveness and benefit of synergy against representative target(s). In FY05, complete detailed concept design of ATE system, conduct feasibility demonstrations of major ATE components with reduced size/weight/power , and continue ATE effects investigations on selected targets to refine/enhance system design requirements. Program will be jointly executed by ARDEC and ARL.	1745	3681	3635	1729
Totals	9975	9729	6846	6729

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602624A - Weapons and Munitions Technology						PROJECT H28	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H28 MUNITIONS TECHNOLOGY	24766	23574	20383	24124	18440	14128	14380	20090

A. Mission Description and Budget Item Justification: This program advances the state of the art for enabling technologies supporting the FCS and the Objective Force. The project focuses on achieving increased lethality using smaller and lighter weapon systems with smaller and lighter armaments. The project funds development of: warheads, both shaped charge (SC) and explosively formed penetrators (EFP); high energy explosives; large-caliber gun propellants with barrel wear reducing additives; insensitive munitions (IM); energetics; advanced materials/processes for warheads; and techniques/processes to address material corrosion. Novel warhead architectures, new initiation techniques and advanced material technologies are being applied to produce smaller, lighter, more effective, multi-role warheads having 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. High-energy, high-density explosives are being developed to increase lethality and optimize design performance. New improved energetic materials developed provide numerous transition opportunities for weapon system upgrades and FCS. Developmental high-impetus propellant formulations, optimized for ETC initiation, offer increased muzzle kinetic energy, precision ignition and unmatched repeatability. The integrated propellant and explosive insensitive munitions program will increase the battlefield survivability of land combat systems and enhance overall safety at manufacturing plants, storage depots, and during air and sea transport. Efforts under this project support the MRAAS ATD, which develops and demonstrates a lightweight, multi-role armament and ammunition system. Analysis and development of Multiple-EFP warheads also supports the Army's Full Spectrum Active Protection System (APS) research and development, performed by the Tank Automotive and Armaments Command's Tank Automotive Research Development and Engineering Center (TACOM-TARDEC) under Program Element (PE) 0603005A. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology

PROJECT
H28

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
MRAAS: In FY02, selected, fabricated and delivered high-energy and high-blast insensitive explosive formulations for FCS multi-purpose warhead concept testing; continued explosive formulation insensitivity improvements and testing; conducted laboratory demonstration of the multi-purpose SC warhead and the maturing Collinear EFP warhead concepts; conducted laboratory demonstrations of revolutionary Generation II EFP and Compact SC warhead designs for FCS multi-role ammo suite and common missile; showed greater than 3 times penetration increase in reduced size warhead; showed compact SC size reduction by 1/2 while maintaining penetration capability. In FY03, prove feasibility of an environmentally friendly, pilot-scale process for selected explosive formulation. Deliver 200 pounds of the candidate high-energy and high blast insensitive explosive formulations for testing in FCS warheads; tailor selected multi-purpose SC and EFP warhead designs for fabrication in the optimum FCS munition configuration; fabricate, characterize and assemble developmental FCS propellant charges for full-up firing demo of ETC propulsion capability in FY04. In FY04, complete optimization of multimode warheads ; demonstrate high energy sensitive explosive. In FY05, conduct beyond line of site (BLOS) flight projectile tests; conduct BLOS projectile warhead demo vs. multiple target types .	10980	9000	11795	10992
Full Spectrum Active Protection: In FY02, proved feasibility of an enhanced multiple EFP warhead for APS applications against both chemical energy (CE) and kinetic energy (KE) threats, with the goal of producing zero residual penetration (i.e., penetration potential remaining after active protection system intercept penetration on target). In FY03, conduct dynamic tests of APS warhead design to validate warhead effectiveness against both CE and the more challenging KE threats. In FY04, integrate APS warhead into counter munition; optimize warhead design with system fuzing. In FY05, conduct dynamic testing of optimized APS warhead integrated into counter munition. This task is complementary to and fully coordinated with work accomplished in PE0602601A and supports demonstration of APS , conducted under PE0603005A.	1600	1500	1825	2136
- Advanced Energetic Materials: Perform critical evaluation and selection of novel/nano energetic materials concepts.	0	2871	3000	3946
-Shaped Charge Warheads: In FY05, determine bash thru loads of targets on warhead and begin hardened SC design. Incorporate new high blast explosive/frag designs.	0	0	0	3733
- Multiple Effects Warhead Technology: In FY04, develop and demonstrate a revolutionary Gen II EFP warhead concept for FCS smart munitions. A greater than 3 calibers long EFP will be designed and demonstrated. In FY 05, optimize Gen II design with aerostable tail configuration to demonstrate enhanced penetration capability at standoff greater than 50 meters.	0	0	3763	3317

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PROJECT
H28

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- This one year Congressional add in Future Combat System Propellant and Survivability develops (and completes development of) advanced propellants to meet the propulsion and survivability requirements of the MRAAS; it will prove feasibility of Generation II ETC gun propellant for FCS cartridge applications providing a 25% increase in performance. No additional funding is required to complete this project.	2687	0	0	0
- This one year Congressional add (Liquidmetal Alloy-Tungsten Alloy Penetrator) demonstrates (and completes demonstration of) a potential alternative material for depleted uranium (DU) for use in medium caliber KE penetrator munitions for the Army, Navy and Air Force. No additional funding is required to complete this effort.	3262	0	0	0
- This one year Congressional add (Multiple Explosively-Formed Penetrators) develops (and completes development of) a unique EFP warhead capable of breaching obstacles, concrete walls and other targets from a man-portable system. No additional funding is required to complete this project.	960	0	0	0
- This one year Congressional add (Single Crystal Tungsten Alloy Penetrator) evaluates (and completes evaluation of) the viability and affordability of single crystal tungsten alloy material as a KE penetrator and validates ballistic performance compared to that of DU; explores viability of a manufacturing process. No additional funding is required to complete this project.	1919	0	0	0
- This one year Congressional add (Cooperative Energetics Initiative) allows the Army to leverage applicable ARDEC technologies with mining, construction and drilling industries research and development for Dual-Use Science and Technology applications. No additional funding is required to complete this project.	3358	0	0	0
The objective of this Congressional add is to support the design and development of a Gen-2 warhead (x-caliber) EFP. No additional funds are required to complete this project.	0	1341	0	0
The objective of this Congressional add is to support the development of a M795 extended range high explosive projectile. No additional funds are required to complete this project.	0	1916	0	0
The object of this Congressional add is to investigate the properties and performance of liquidmetal tungsten alloy penetrators. No additional funds are required to complete this project.	0	4072	0	0
The object of this Congressional add is to investigate the properties and performance of single crystal tungsten alloy penetrators. No additional funds are required to complete this project.	0	2874	0	0
Totals	24766	23574	20383	24124

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602705A - ELECTRONICS AND ELECTRONIC DEVICES

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	48000	59682	33694	42005	47066	44630	44163	44957
EM4 ELECTRONIC DISPLAY RESEARCH	8609	0	0	0	0	0	0	0
H11 BATTERY/IND POWER TECH	17226	30858	7320	12929	17488	13651	12781	12892
H94 ELEC & ELECTRONIC DEV	22165	28824	26374	29076	29578	30979	31382	32065

A. Mission Description and Budget Item Justification: This program element provides enabling capabilities for the Objective Force by researching and investigating 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 electronic components, power components, frequency control and timing devices, display technologies, and low-cost, lightweight, high-energy density power sources for communications, target acquisition, and miniaturized displays, for applications such as the Future Combat Systems (FCS) and soldier systems. This program consists of research in the physical sciences essential to all land combat systems that contain any of the following component technologies: electronics, photonics, magnetic materials, ferroelectrics, microwave and millimeter-wave components, batteries, electromechanical systems (engine generator sets) and fuel cells. Supported systems 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory and the Army Communications and Electronics Research Development and Engineering Center Fort Monmouth NJ. This PE supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

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<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	49965	27448	30167	31664
Current Budget (FY 2004/2005 PB)	48000	59682	33694	42005
Total Adjustments	-1965	32234	3527	10341
Congressional program reductions				
Congressional rescissions		-2760		
Congressional increases		36550		
Reprogrammings	-951	-342		
SBIR/STTR Transfer	-1014	-1214		
Adjustments to Budget Years			3527	10341

Change Summary Explanation:

Significant Changes:

FY04-05: Funds realigned to increased investments in power and energy, and prognostics and diagnostics efforts.

FY03 Congressional Adds:

Logistics Fuel Reformer Development Program, Project H11 (\$1750); Center for Advanced Fuel Cell Technology, Project H11 (\$2000); Soldier Fuel Cell System, Project H11 (\$1050); Cylindrical Zinc Air Battery for Land Warrior Applications, Project H11 (\$1000); Improved High Rate Alkaline Cell, Project H11 (\$1000); Rechargeable Cylindrical Cell System – Lithium Ion/Nickel Metal Hydride, Project H11 (\$1000); Dry Polymer Extrusion for Battery Cathode and Electrode Research, Project H11 (\$3700); Extrusion on Multilaminate Battery Packaging, Project H11 (\$4500); Solid State Polymer Battery for Land Warrior System, Project H11 (\$1000); Intelligent Power Control for Sheltered Systems, Project H11 (\$3800); Liquid Silicone Lithium Rechargeable Battery, Project H11 (\$1500); Low Cost Reusable Alkaline Manganese-Zinc, Project H11 (\$600); Flat Panel Displays, Project H94 (\$7000); Display and Development and Evaluation Laboratory, Project H94 (\$1750); Miniature and Micro Fuel Cells, Project H11 (\$3500); Portable Hybrid electric power systems, Project H11 (\$1400).

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602705A - ELECTRONICS AND ELECTRONIC DEVICES					PROJECT H11			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H11 BATTERY/IND POWER TECH	17226	30858	7320	12929	17488	13651	12781	12892	

A. Mission Description and Budget Item Justification: This project conducts applied research to identify, advance and enhance emerging power generation and power management technologies for the Objective Force. There is a critical need for ultra-lightweight manportable power, chargers, and power management for the dismounted soldier in support of Land Warrior and Objective Force Warrior (OFW). Mobile electric power sources that are smaller and more fuel efficient are key enablers for tactical sustainability and survivability. This project researches advancements in energy conversion, electrochemistry, and signature suppression technologies, including those for primary batteries, rechargeable battery hybrids, fuel cells, power management, and components for electromechanical power generation. It will provide (1) high energy and high power density hybrid power source components that combine the best features of individual power technologies, (2) rapid recharging systems, and (3) power management through low power design tools and software operating system dynamic power management. It will provide the OFW and other OF 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 High Energy, Cost-Effective Primary and Rechargeable Batteries program will modify cost-effective commercial battery technologies to provide advanced high energy batteries and hybrid power sources that can be used for both training and combat. The Integrated Power Generation and Management Technologies program will provide high energy, low cost and fuel-efficient non-battery portable and mobile power sources and investigate low power technologies to reduce the power consumption of future electronic devices. The Portable and Mobile Power Sources for the Objective Force program will mature various emerging power source technologies to provide high energy, low weight portable power sources for Land Warrior, the Objective Force Warrior, and mobile electric power sources for Objective Force platform applications. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

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PROJECT
H11

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
-High Energy, Cost Effective Primary and Rechargeable Batteries: Completed a four year effort in High Energy, Cost Effective Primary and Rechargeable Batteries. Tested, in the field, a forward area battery charging system comprised of a high energy metal-air battery and smart charging cables; provided a prototype battery with energy density greater than 300 watt hours/kilogram, and evaluated a proof-of-concept electrochemical capacitor for hybrid digital pulse C4I applications with 10 times power density and two to four times energy density, integrated into a hybrid power source for field testing in digital pulse C4I and high-power vehicle applications that lasts more than three times the battery alone in the same envelope.	1169	0	0	0
- Integrated Power Generation and Management Technologies: Completed a three year effort in Integrated Power Generation and Management Technologies. Tested, in the field, a scalable power electronics package in a five kilowatt engine generator set; tested, in the laboratory, power on-the-move capabilities. Tested, in the field, a battery/battery hybrid; tested, in the field, a kinetic energy harvesting system; integrated components for a stand-alone 500 watt thermophotovoltaic (TPV) power source. Enhanced the initial low power design tool for additional power consumption reductions in soldier systems; implemented and tested power management techniques for soldier systems on a distributed test bed.	2997	0	0	0

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602705A - ELECTRONICS AND ELECTRONIC
DEVICES

PROJECT
H11

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
- Portable and Mobile Power for the Objective Force: This effort researches Hybrid Power Source and Power Management technologies for Land Warrior (LW) and the Objective Force Warrior (OFW). The effort investigates technology components including Low Temperature Ionic Membrane Development, Mobile Power Fuel Cell Development, Micro Power Source Development for Sensors, Logistic Fuel Meso/Micro Engine Development, and Power Management Development for OFW, 10 kW Generator Component Development, Logistic Fuel Reformers for 1-2 kW Fuel Cells, and Battery Charger Development. In FY03, researches and laboratory demonstrates system level smart charger technology for mobile platform with 2.5 hr recharge for LW LI7 battery, system metal-air/lithium battery hybrid power source (4 lbs) with 200 Wh/kg, and 300 Wh/kg re-fuel. In FY04, investigates 10 kW proof-of-concept system components leading to quiet, smaller, and fuel-efficient generator, investigates safe polymer lithium-ion rechargeable LW LP10 battery (2 lbs) with 170 Wh/kg. In FY05, demonstrates system level smart charger technology with 2 hr recharge integrated for LW LP10 battery, 1-2 kW reformed logistic fuel cell components for scout vehicle silent watch, lighter weight battery hybrid power source (3.5 lbs) with 250 Wh/kg, 350 Wh/kg re-fuel for soldier systems, and power management software with 50% power reduction in operating system of LW, investigates logistic fueled meso/micro power components leading to hybrid power source for OFW.	0	4331	7320	12929
- Congressional Adds for Logistics Fuel Reformer Development Program: The objective of this one year congressional add is to integrate microchannel reformer technology components into an integrated system for both a man-portable methanol fuel reformer and a multi-kilowatt sulfur-laden fuel reformer. No additional funding is required to complete this project.	0	1668	0	0
- Congressional Adds for Center for Advanced Fuel Cell Technology: The objective of this one year congressional add is to research micro fuel cell technologies to include (1) new electrolytes and catalysts, (2) improved membranes, and (3) heat and water management. No additional funding is required to complete this project.	0	1908	0	0
- Congressional Adds for Soldier Fuel Cell System: The objective of this one year congressional add is to test and evaluate a prototype fuel cell system under various combat scenarios. No additional funding is required to complete this project.	0	1002	0	0
- Congressional Adds for Cylindrical Zinc Air Battery for Land Warrior Applications: The objective of this one year congressional add is to investigate and integrate the Cylindrical Zinc Air Battery for Land Warrior. No additional funding is required to complete this project.	0	955	0	0
- Congressional Adds for Improved High Rate Alkaline Cell (or CFx): The objective of this one year congressional add is to incorporate cells into batteries and test under various simulated equipment load scenarios. No additional funding is required to complete this project.	0	955	0	0

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602705A - ELECTRONICS AND ELECTRONIC DEVICES

PROJECT
H11

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Congressional Adds for Rechargeable Cylindrical Cell System - Lithium Ion/Nickel Metal Hydride: The objective of this one year congressional add is to test and evaluate Rechargeable Cylindrical Cell System under extreme temperatures. No additional funding is required to complete this project.	0	955	0	0
- Congressional Adds for Dry Polymer Extrusion for Battery Cathode and Electrode Research: The objective of this one year congressional add is to research high conductivity electrodes and electrolytes that will be incorporated in cells for testing and evaluation. No additional funding is required to complete this project.	0	3531	0	0
- Congressional Adds for Extrusion on Multilaminate Battery Packaging: The objective of this one year congressional add is to incorporate multilaminate recipes into lithium-ion cells for test and evaluation. No additional funding is required to complete this project.	0	4293	0	0
- Congressional Adds for Solid State Polymer Battery for Land Warrior System: The objective of this one year congressional add is to investigate lithium-ion cells with newly developed high-conductivity polymer electrolyte. No additional funding is required to complete this project.	0	955	0	0
- Congressional Adds for Liquid Silicone Lithium Rechargeable Battery: The objective of this one year congressional add is to investigate additives to decrease the flammability of electrolytes. No additional funding is required to complete this project.	0	1431	0	0
- Congressional Adds for Low Cost Reusable Alkaline Manganese-Zinc: The objective of this one year congressional add is to test and evaluate batteries in the 5590 configuration under SINCGARS load scenario. No additional funding is required to complete this project.	0	573	0	0
- Congressional Adds for Miniature and Micro Fuel Cells: The objective of this one year congressional add is to investigate materials and stacks for miniature and micro fuel cell applications. No additional funding is required to complete this project.	0	3340	0	0
- Congressional Adds for Portable hybrid electric power systems: The objective of this one year congressional add is to investigate methanol concentration measurement and control issues, system balance-of-plant optimization and control, DMFC/Li-ion hybridization issues, and model development including both detailed and system-level models. No additional funding is required to complete this project.	0	1335	0	0

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602705A - ELECTRONICS AND ELECTRONIC DEVICES

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Congressional Adds for Intell Pwr Control for Sheltered Sys: The objective of this one year congressional add is to investigate small, modular, distributed shelter power management system, lightweight intelligent power distribution systems, automatic power adapter switches, IPMS integrated smart chargers for smart batteries, high energy energy density battery bank/Uninterrupted Power Supply, highly efficient miniature DC to DC converters, remote monitoring and control HW/SW of integrated power management system, and studies into potential power management of unmanned ground systems (UGSs), unmanned ground vehicles (UGVs) and on-the-move systems. No additional funding is required to complete this project.	0	3626	0	0
Power Sources for the Dismounted Soldier: The objective of this one year congressional add was to investigate the following: a cylindrical zinc-air cell for Land Warrior, fuel cell for soldier systems, an improved high rate alkaline cell, a logistics fuel reformer, and a rechargeable cylindrical cell system. No additional funding is required to complete this project.	7532	0	0	0
-Power Sources for Non-Objective Force Applications: The objective of this one year congressional add was to investigate the following: low cost reusable alkaline manganese-zinc batteries, polymer extrusion/multilaminate processes, and a cylindrical battery replacement for a tube-launched optically-tracked wire-guided missile, improved target acquisition system. No additional funding is required to complete this project.	4562	0	0	0
Congressional Add: The objective of this one year congressional add was to investigate heat actuated coolers for portable military applications. No additional funding is required to complete this project.	966	0	0	0
Totals	17226	30858	7320	12929

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602705A - ELECTRONICS AND ELECTRONIC DEVICES					PROJECT H94			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H94 ELEC & ELECTRONIC DEV	22165	28824	26374	29076	29578	30979	31382	32065	

A. Mission Description and Budget Item Justification: This project supports applied research in the application of the sciences of physics, electrochemistry, biotechnology and electronics to advance power generation, Command, Control, Communications, Computers (C4) and Intelligence, Surveillance and Reconnaissance (ISR) technologies for the Future Combat Systems (FCS) and the Objective Force. These technologies support thrusts aimed at enhanced battlefield situational awareness, increased vehicle mobility, reduced acquisition cost, and reduced operations and support costs; they are critical to the realization of the vision of a medium weight force with the capability to detect, target, and engage the enemy of the future. The technical areas addressed under this project are: frequency control; electro-optic sensors to include eye safe laser radar and midwave infrared (MWIR, 3- to 5-micron) and longwave (LWIR, 8- to 12-micron) bands; microelectromechanical systems (MEMS) for multi-function radio frequency (RF) applications as well as smart munitions (e.g., inertial measurements); advanced 16-18, 35, and 95 GHz (Ku, Ka and W-band) modules for RF applications; high temperature high power inverter circuits for all-electric vehicles; microturbines; prognostics and diagnostics to reduce logistics demands; and advanced lithium-ion batteries, metal/air batteries, fuel reformer, fuel cells for hybrid power sources for individual soldier applications and FCS. Technical barriers include: more stable oscillators for frequency control in communications and location finding, more complete understanding of fundamental properties, growth techniques, and processing of new materials and their exploitation in electronic devices for high performance infrared detectors, high voltage and high power control electronics; MEMS device design and fabrication techniques; RF microcircuit design; high power and high voltage power materials and device design, more energetic electrodes, more conductive and stable electrolytes for batteries and fuel cells, compact fuel reformers to provide hydrogen for fuel cells. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, Project reliance and supports the Objective Force transition path of the Transformation Campaign Plan. This program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). No Defense Emergency Response Funds were provided to the project.

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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Mature components and software for C4 technology. Mature affordable design concepts for an integrated radio frequency sensor which performs radio, radar, and control functions to allow communications, combat-ID, target acquisition and track, active protection, and munition command guidance through a single antenna for use on small ground and air vehicles. Perform research in advanced tactical software tools for mobile, ad hoc network access control, intrusion detection, and authentication techniques for the objective force. In FY02, completed fabrication of Ka-Band multifunction testbed modules for evaluation of research concepts and conducted laboratory experiments on agent based vulnerability assessment tools for low bandwidth networks. In FY03, complete integration of solid state modules into 2D Escan antenna. Predict attack types by identifying mobile ad hoc network vulnerabilities and postulate concepts for solutions. In FY04, complete design and testing of planar, polarimetric radiating elements for wide bandwidth mmW arrays; and identify automated agent based deployment techniques and verify there robustness through experiments. In FY05, complete True Time Delay beam steering in 2 dimensions for widebandwidth, high-resolution RF sensors and provide techniques and software codes for autonomous use in the field to prevent intrusions and to repel attacks.</p>	2662	1762	1600	1600
<p>- Investigate micro and nano technology for small low cost highly reliable RF MEMS switches, resonators and filters for multifunction . In FY02, experimentally verified finite element modeling for design of RF MEMS switch, filter and resonators using smart material, lead zirconate titanate, for multifunction RF applications. In FY03, fabricate Aluminum Nitride (AlN) resonators for high frequency filter applications. In FY04, initiate reliability testing of 1st generation AlN MEMS resonators and design 2nd generation resonators for high frequency filter applications. In FY05, examine the performance of E-Beam lithography in patterning nanoscale RF structures for FCS and OFW communications.</p>	1036	750	1115	1300
<p>- Investigate and provide the world's first high-temperature matrix converter for motor drive applications (future electric vehicles) using silicon carbide technology. In FY02, completed and evaluated 4 kW silicon carbide bi-directional switch as a proof-of-principle, high temperature circuit for matrix converter. In FY03 fabricate silicon carbide power devices and implemented world's first high-temperature bi-directional switch (10 kW) for development of high-temperature matrix converter for motor drive applications. In FY04 fabricate and validate a 10 kW silicon carbide (SiC)-based high-temperature matrix converter for motor control and a 300 kW Si-based matrix converter for power distribution. In FY05 Implement a high-temperature controller circuit for 10 kW matrix converter.</p>	1613	1800	1650	350

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Design highly stable, low-acceleration sensitivity, low-noise oscillators, by integrating the high quality factor of photonic resonators and conventional microwave components for improved Future Combat System radar systems engaging in slow moving target detection. In FY02, completed the design of very low phase noise oscillators and first prototype units have been fabricated for the low radar doppler system. In FY03 assess noise characteristics for fiber optic opto-electronic oscillator (OEO) and model performance. In FY04, evaluate performance of microsphere based OEO with performance suitable for moving target indicator (MTI) sensors. In FY05, test phase locked microsphere based stabilized local oscillator (STALO) with RF Frontends.	2879	2900	2500	1900
- Investigate new component materials, structures and EM issues to enhance the performance of mmW components and active devices, such as vacuum electronic devices (VEDs) and millimeterwave integrated circuits (MMICs), and to enhance integration. In FY02, designed a new temperature stable ferroelectric dielectric material for compact antenna phase shifters and new piezoelectric resonators with ten times lower acceleration sensitivity have been used in the design of oscillator and filter applications for mobile Future Combat Systems. In FY03, complete fabrication of Ka- and Q band millimeter power modules (MMPMs) for EW and radar applications. In FY04, integrate VE tube with semiconductor amplifier and power supply in MMPMs and characterize. In FY05, evaluate new components to support design of next generation mmW active apertures.	1958	1700	2250	2426
- Research and design improved, millimeter-wave solid-state devices based on new device materials and structures to achieve higher output power, power-added-efficiency, linearity, and dynamic range for increased operation and detection range in systems such as FCS, UAV and soldier system. In FY02, completed compact multichannel transmit/receive (T/R) module designs prototype units for integration to antenna and beam forming network for system evaluation. In FY03, evaluate prototypes in two-dimensional (2D) Escan and create enhanced design with new higher dynamic range MMICs from FCS-Comms program. In FY04, assess performance of microwave/millimeter wave wide bandgap (WBG) devices and circuits. In FY05, complete T/R module incorporating wide bandgap (WBG) based MMICs to support tactical unmanned aerial vehicles (TUAV) SAR/MTI radar.	1843	1400	775	1500

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Accomplishments/Planned Program (continued)

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Investigate technology for advanced batteries, fuel reformers and fuel cells to be used in hybrid power sources for the objective force warrior, future combat systems (e.g., electromagnetic armor and smart munitions. In FY02, formulated an experimental rechargeable Lithium (Li)-ion battery chemistry with flame-retardant electrolyte and nanophase electrode material. In FY03, investigate a Li/air battery chemistry for very high specific energy battery charger. In FY04, formulate and evaluate new catalysts for efficient hydrocarbon reformation for fuel cells. In FY05, provide technology for an advanced high-energy rechargeable battery with low flammability/ good charge retention at high temperatures and for a Li/air battery and for fuel cell systems utilizing carbonaceous fuels. (This work is in support of project AH11.)	2073	1400	1550	1500
- Investigate eye-safe scannerless 3-D imaging laser radar for both long-range FCS and short-range unmanned ground and air vehicle applications. In FY02, completed laboratory concept demonstration of scannerless 3-D imaging laser radar. In FY03, demonstrate a scannerless laser radar breadboard system in the field. In FY04, integrate eye-safe components, laser and detector operating at 1.5 um, into radar breadboard system. In FY05, demonstrate an improved eye-safe version, field test, and collect data to show functionality for target acquisition and robotic navigation.	3376	2300	450	450
- Investigate multi-color infrared (IR) imaging cameras, small pixel focal plane arrays (FPAs) capable of both passive IR and active laser detection and acousto-optical tunable filter (AOTF) based hyperspectral imagers for target detection and identification for FCS, countermine, active protection, and other Army applications. In FY02, used dual-color long-wave camera to show detection of recently buried mines. In FY03, show feasibility of an integrated sensor using large-area dual-color MWIR/LWIR detector arrays and 3-D imaging laser radar for target acquisition and identification for FCS vehicles. In FY04, demonstrate improved long-wave IR AOTF for hyperspectral imaging. In FY05, demonstrate provision of mid-wave IR azimuth and elevation tracking information to radar kinetic energy projectile tracker for FCS vehicle survivability active protection system.	2995	3636	2100	2100

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Research semiconductor superlattice and quantum dot materials for high operating temperature, high-performance IR detectors and mid-wave infrared (MWIR) quantum cascade lasers to reduce the cost of FCS and other Army sensors. In FY02, demonstrated room-temperature pulsed operation for systems such as systems such as missile countermeasure laser radar or chemical/biological agent detection. In FY03, show continuous-wave operation at temperatures reachable by inexpensive thermoelectric coolers. In FY04, demonstrate operation of quantum dot detectors at temperatures significantly higher than required for present state-of-the-art high-performance IR detectors, showing potential for lower-cost sensors. In FY05, demonstrate low defect density antimony-based superlattice material for future high operating temperature IR detectors.	1730	2353	2484	2450
- Investigate optical limiter designs with promising nonlinear materials in realistic, emulated Army imaging devices for enhanced survivability. In FY03, characterize highly nonlinear reverse saturable absorbing (RSA) dyes in low frequency number testbeds. In FY04 fabricate and characterize the nonlinear properties of phase change materials (such as fast switches), sacrificial materials. In FY05 have characterized mercury mirrors, engineered RSA materials, two-photon absorbing materials and characterize highly nonlinear optical materials (such as large pi-conjugated organic molecules).	0	350	1000	1000
- Investigate a broad base of extremely quick, accurate, and small photonic devices to detect biological point and remote agents to enhance soldier survivability. In FY04, demonstrate MEMS based and interferometric chemical detection. In FY05, demonstrate remote particle scattering biosensor.	0	0	1500	1500
- Investigate, design and fabricate a micro electro mechanical system (MEMS) based micro-gas turbine generator for producing electricity and cooling for the dismounted soldier for the Objective Force Warrior and beyond. In FY04, the micro gas turbine will be operated using hydrogen as fuel. In FY05, provide the first hydrocarbon fueled turbojet generator.	0	0	1000	3000
- 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 logistics decision support systems to extend operational life and minimize downtime via condition-based maintenance. In FY04, design and demonstrate combined MEMS and nanotechnology sensor concept models. In FY05, conduct validating experiments on MEMS/nanotechnology sensors.	0	0	2400	3000
- In FY04 mature flexible display backplane, electronics and materials. In FY05, mature flexible display technology to develop prototypes.	0	0	4000	5000

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Flat Panel Displays: The objective of this one-year Congressional add is to improve the quality of equipment and materials available from U.S. suppliers for flat panel display technologies; to identify and insert improvements into manufacturing, pre-production and pilot facilities; and to establish standards and manufacturing benchmarks for the flat panel display industry. No additional funding is required to complete this project.	0	6779	0	0
- Display and Development and Evaluation Laboratory: The objective of this one-year Congressional add is to conduct research in the fabrication and characterization of luminescent materials, components, and prototype display devices for flexible displays; and to create a database of information on display technologies and vendors. No additional funding is required to complete this project.	0	1694	0	0
Totals	22165	28824	26374	29076

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602709A - NIGHT VISION TECHNOLOGY						PROJECT H95	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H95 NIGHT VISION & EO TECH	22172	19696	22233	22420	24359	27155	28464	29997

A. Mission Description and Budget Item Justification: This Program Element (PE) researches, investigates and applies core night vision, and electronic sensor technologies to improve the Army's capability to operate in the dark, i.e., "Own the Night." The technologies covered in this PE have the potential to provide the Army with new, or enhanced, capabilities to see farther on the battlefield, operate in obscured conditions, and maintain a higher degree of situational awareness (SA). The Micro-Eyesafe Solid State Laser Sources program will have the potential to provide the individual soldier with high performance tactical laser range-finding, target designation, obstacle avoidance, and laser radar. Innovative near infrared (NIR) and short wavelength infrared (SWIR) sensors will provide increased range for target identification. Advanced focal plane array (FPA) components will be developed for cooled and uncooled infrared sensors. A Disposable Sensors Network project will be performed in concert with Army Research Laboratory (ARL) and will apply industry expertise in high volume, low cost electronic components and imaging systems to demonstrate prototypes. This program will focus on developing mature key technologies for very small, low cost multi-functional unattended ground sensors to be disbursed on the battlefield and fuse data to help detect & classify threats. In addition, imaging sensors will be designed and fabricated for the Anti-Personnel Landmine Alternative program. The Low Power Display Components program will reduce power consumption by >50 percent over existing helmet mounted miniature displays, enabling the warfighter to execute longer missions with less head-borne weight and logistics burden. The technology products will be miniature flat panel displays that consume less power, save weight and space, support both monochrome and full-color applications, have high-image fidelity, and integrate easily with current and next-generation sensors. Also, the design and fabrication of advanced electronics in order to improve the contrast and brightness of miniature head mounted flat-panel displays that will be used by infantry, armored, aviation, and field maintenance organizations will be researched. Aided/Automatic Target Recognition (ATR) technologies will be researched to dramatically reduce the time necessary to acquire targets, and collect intelligence data. 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 program. Multispectral sensor simulations will support end-to-end predictive modeling and evaluation of new technologies in a virtual environment. Third (3rd) Generation Forward Looking Infrared (FLIR) Technology will develop focal plane array technology for the next generation forward looking infrared sensors to provide target identification at current detection ranges and for high speed, on-the-move target recognition. Three dimensional (3D) imaging of military targets at tactical ranges using laser radar (LADAR) is expected to provide superior target identification capabilities for future Army vehicles using the Compact Lightweight 3D Sensors program. This effort will leverage the Defense Advanced Research Projects Agency (DARPA) 3D Flash Imaging Program that is currently developing integrated focal plane detector arrays and read out integrated circuits. The focus of the joint ARL/Communications and Electronics Command (CECOM), Warrior Extended Battlespace Sensors program is to develop the concepts and components for a family of affordable, unattended ground sensors that will improve situation awareness and targeting in complex terrain. Work in this PE contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0602705A (Electronics and Electronic Devices), PE 0602712A (Countermines Technology), and PE 0603710A (Night Vision Advanced Technology). Work in this PE is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on Sensors and Electronic Devices.

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This program is managed by the Communications-Electronics Research, Development and Engineering Center, Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program/project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Disposable Sensors Network. In FY04, research low cost, throw away visible/near infrared active pixel imaging sensors and non-imaging sensors for increased situational awareness and survivability in open and complex terrain operations. Investigations of video sensor technology include low cost passive and actively augmented technologies for all weather, day/night capability and studies of multi-sensor network optimization for full spectrum operations. In FY05, conduct initial demonstration of low cost video sensor technology in a distributed aperture configuration. Determine practical limitations of power, footprint, and cost of passive and actively augmented video based CMOS technology for ground-based networks, consider feasibility of sensor architectures for micro air vehicles, and identify optimal suite of traditional and non-traditional sensor technologies to comprise Disposable Sensors Network.	0	0	1940	1904
Soldier Vision System Components. In FY03, research via trade studies, optimal head-mounted configurations for multispectral indirect view pixel fusion components and investigate a miniature 1280 x 1024 video-based low light level mobility sensor. Research pixel fusion processors with image registration, non-uniformity correction, and video optimization algorithms. In FY04, research imaging brass board helmet mounted 1280 x 1024 image intensifier and electron bombarded video-based mobility sensor and uncooled FLIR. Investigate a small pixel 1280 x 1024 or larger color micro display and low power uncooled FLIR electronics. Research initial pixel fusion of multisensor imagery vision board set with low light sensor and down select. In FY05, investigate 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. Research development of large format (1600 x 1200/High Definition TV) low light video sensors for phase II Objective Force Warrior transition.	0	1149	5314	5204
Warrior Extended Battlespace Sensors. In FY02, demonstrated infrared micro camera technology. In FY03, develop and deliver affordable infrared micro-cameras for netted micro-sensor field applications; uncooled infrared sensor materials for stable low cost infrared cameras; and acoustic and infrared image sensor fusion algorithms for positive target identification and multiple target deconfliction.	3895	3666	0	0

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Overhead Sensor Technology for Battlefield Characterization. In FY02, this joint CECOM NVESD/Space and Missile Defense Command project researched advanced overhead sensor technologies for wide area battlefield event detection, discrimination, and identification in near real time. In FY03, NVESD will develop and deliver large format (1024x1024) long-wavelength and mid-wavelength infrared focal plane arrays for incorporation into hyper-spectral imaging systems.	770	621	0	0
The Micro-Eyesafe Solid State Laser Sources. This effort successfully developed several new ultra small, low cost, eyesafe lasers for Army applications. The "monoblock" laser has been transitioned to a compact, handheld, multifunction laser for the soldier and is also planned for the Cost Effective Targeting System, a Future Combat Systems (FCS) application. A diode pumped Er:glass micro-laser is being transitioned for use in the objective individual combat weapon (OICW) fire control system.	904	0	0	0
Low Power Display Components. In FY02, developed monochrome 1280x1024 active matrix liquid crystal display at 2,600 ft-Lambert, meeting Comanche requirements. Developed low power color 800x600 active matrix organic light emitting diode display for Land Warrior/Objective Force Warrior requirements. In FY03, research full color 1280x1024 display components for see-through and high-resolution applications. Complete development of ambient optical-channel attenuators and color optics to enhance display performance.	4873	4286	0	0
Distributed Aided Target Recognition (ATR) Evaluation Center of Excellence. In FY02, conducted Multi-Function Staring Sensor Suite (MFS3) data collection and assessed the performance of the sensor. In FY03, complete assessment and evaluation of MFS3 ATR algorithms and hardware for FCS. In FY04, evaluate and assess automatic and aided target recognition algorithms using experimental sensor imagery obtained from field collection in multiple wavebands for evaluating 3rd generation cooled sensor algorithms design and development for future FCS insertion. In FY05, extrapolate findings and expand evaluation and assessment of ATR algorithms.	1072	966	1184	1188
Dual Band Detector Imaging Technology. In FY02, this one-year Congressional add investigated dual band detector imaging technology. Specifically, it researched improved processes to fabricate small-pixel, two color, large format FPAs. No additional funding was required to complete this project.	2543	0	0	0
3rd Generation Forward Looking Infrared (FLIR) Technology. In FY02, investigated laser range finding and target profiling on the same array. In FY03, research integrated, multicolor, large area (1000x2000) focal plane array with parallel, optical readouts, active laser radar (LADAR), and 120K operating temperature.	4483	4948	0	0

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	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<u>Accomplishments/Planned Program (continued)</u>				
Advanced Sensor Modeling and Simulation. In FY02, established metric for sensor fusion and low observables. In FY03, implement "Paint the Night" image design tool onto computer hardware for static scenes. In FY04-05, research and deliver a new Field-of-View (FOV) search model for integration into the Combined Arms and Support Task Force Evaluation Model and OneSAF Testbed.	3632	4060	4292	4567
Compact Lightweight 3D Sensors. In FY04, design a low cost, lightweight, compact eyesafe laser transmitter for designators at 1.5 micron wavelength and a 256 x 256 3D flash LADAR FPA. Model the laser for optimum output power and range performance for short and long-range applications. In FY05, begin building a novel end-pumped solid state laser erbium yttrium aluminum garnet (Er: YAG) prototype compact laser (greater than 100 mj, 1 ns, 30 Hz) at 1.5 micron wavelength.	0	0	2148	2523
Low Cost High Resolution Focal Plane Array: In FY04, design a multispectral tunable array (1280 x 720) and read-out integrated circuit (ROIC). Model the multispectral tunable sensor configuration for narrow spectral resolution of 100 nm, range of spectral tunability (8-12 um) and photon collection efficiency, while maintaining a narrow band collection capability. Concurrently in FY04, design a multiband uncooled IR sensor (midwave/longwave) in high definition television format of 1280 x 720 array and readout. Model the sensor for 1/f noise, range and bandwidth. In FY05, build the detector array and ROIC to the modeled configurations and specifications. Begin building the micro-electronic mechanical structures (MEMS) prototype to size to demonstrate feasibility. Simultaneously in FY05, build the array and incorporate advanced photolithography techniques to demonstrate a 20-micron pitch for co-located materials with different spectral responses.	0	0	7355	7034
Totals	22172	19696	22233	22420

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<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	22993	22333	22434	23718
Current Budget (FY 2004/2005 PB)	22172	19696	22233	22420
Total Adjustments	-821	-2637	-201	-1298
Congressional program reductions				
Congressional rescissions		-2461		
Congressional increases				
Reprogrammings	-644	-113		
SBIR/STTR Transfer	-177	-63		
Adjustments to Budget Years			-201	-1298

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602712A - Countermines Systems

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	21995	16857	21291	21422	20840	27918	29190	29467
H24 COUNTERMINE TECH	19733	14440	18648	18687	18010	25037	26245	26455
H35 CAMOUFLAGE & COUNTER-RECON TECH	2262	2417	2643	2735	2830	2881	2945	3012

A. Mission Description and Budget Item Justification: This Program Element (PE) researches and investigates advanced technologies to improve countermines, signature management and counter sensors capabilities for the Army's Transformation to the Objective Force. Countermines research focuses on concepts and technologies that improve mine detection and neutralization using standoff man-portable, ground and air platforms. The goal is to increase mine detection probability, while reducing false alarm rate, and to maintain high operational tempo in the Objective Force. Countermines phenomenology of booby-traps, improvised explosive devices, and surface and buried mines will be investigated and models developed for exploiting novel sensing devices in conjunction with the Research, Development and Engineering (RD&E) Center and Corps of Engineers. In addition, wide area airborne countermines sensor concepts are being developed for higher altitude, wide area coverage and higher probability of detection and lower false alarm rate for airborne mine detection. This PE addresses emerging mine threats in both the conventional and electronically activated categories. A Center of Excellence for Countermines has been established to coordinate and standardize land mine signature models; maintain a catalogue of mine signatures; and support the evaluation of mine detection sensors and algorithms. This PE also researches deception signature management and counter sensor techniques that will potentially alter an adversary's perception of friendly force capabilities and intentions. This effort is coordinated with the Marine Corps. The work in this PE is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. It adheres to Tri-Service/Project Reliance Agreements on conventional air/surface weapons and ground vehicles. This PE contains no duplication with any other effort within the Army, or the Department of Defense. It also is fully coordinated with PE 0602709A (Night Vision and Electro-Optics Technology), PE 0603606A (Countermines and Barrier Development) and PE 0603710A (Night Vision Advanced Technology). This PE is managed by the Night Vision Electronic Sensors Directorate, Communications-Electronics Research, Development and Engineering Center. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP). No Defense Emergency Response Funds (DERF) were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602712A - Countermine Systems

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	22889	13186	15804	14111
Current Budget (FY 2004/2005 PB)	21995	16857	21291	21422
Total Adjustments	-894	3671	5487	7311
Congressional program reductions				
Congressional rescissions		-507		
Congressional increases		4700		
Reprogrammings	-313	-97		
SBIR/STTR Transfer	-581	-425		
Adjustments to Budget Years			5487	7311

Change Summary Explanation:

FY04 (+5200) Added for Wide Area Airborne Countermine Technology
 FY05 (+5200) Added for Wide Area Airborne Countermine Technology

FY03 Congressional Adds:

Polymer-based Landmine Detection, 62712 H24, (\$1400);
 Acoustic Landmine Detection, 62712 H24, (\$3300)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602712A - Countermines Systems						PROJECT H24	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H24 COUNTERMINE TECH	19733	14440	18648	18687	18010	25037	26245	26455

A. Mission Description and Budget Item Justification: This project supports the Objective Force by researching new countermines technologies using man-portable, ground-vehicular, and airborne platforms for standoff detection and discrimination of individual mines and minefields. Mines include both conventional and electronically activated mines. Data collections will be used to assess the ability of various sensor combinations and signal processing/fusion algorithms to consistently detect mines with reduced false alarms for increased force operational tempo. Forward-looking mine detection and neutralization technologies will be emphasized to allow for rapid movement of forces. Investigate the phenomenology of booby-traps, improvised explosive devices, surface and buried mines, and develop models for exploiting novel sensing devices. Additionally, this project develops sensors for the detection of off-route mines. The 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 work on the countermines environment with the Corps of Engineers. No Defense Emergency Response Funds (DERF) were provided to the program/project. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Center of Excellence for Countermines Technologies: This DoD center provides continuous and global surveillance of possible detection and neutralization efforts. The mission is to identify possible Countermines Technologies for investigation by the Services for insertion into mission programs.	482	482	488	487
Wide Area Airborne Countermines Technologies: In FY02, investigated and assessed sensor technologies and collected sensor data for signal processing/clutter rejection to support trip wire, off-route, and side attack wide area minefield detection and surveillance from airborne platforms. In FY04, continue the testing and characterization of a variety of airborne sensor technologies and collect image data for signal processing/clutter rejection to support wide area minefield detection. Pacing technologies include multi-spectral Long Wave IR/Short Wave IR (LWIR/SWIR), ultra wideband ground penetrating synthetic aperture radar and development of autonomous target recognition algorithms for clutter rejection. In FY05, focus will be to obtain measurements in alternative environments and its analysis and conduct extensive clutter data.	3374	0	5101	5078

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602712A - Countermines Systems

PROJECT
H24

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
FCS Mine Detection and Neutralization: In FY02, investigated vehicle mounted standoff mine detection and neutralization capabilities that will provide the warfighter enhanced operational tempo during route clearance and mine avoidance missions. In FY03, continue research of forward-looking mine detection and neutralization technologies. The primary objective of this program in FY 04 is to continue research and investigations, and evaluate forward detection and neutralization of on-route surface and buried antitank mines. In FY05, continue evaluation of forward detection and neutralization of on-route surface and buried antitank mines.	7400	7259	6206	3237
Explosive Specific Sensors and Clutter Rejection: The objective of this effort is to develop and evaluate sensors capable of specifically detecting explosive signatures and assess their potential for deployment on handheld, vehicular mounted, robotic, and airborne platforms. This capability will allow rapid detection of explosive chemicals for immediate confirmation of landmine or unorthodox or novel explosive devices presence with the potential for dramatic reduction in false alarms. In FY05 chemical signature studies will be performed to increase the understanding of the evolution of a chemical signature as function of soil types, time, mine types, etc.	0	0	0	2123
Polymer-based Landmine Detection: The objective of this Congressionally directed, FY03 effort is to conduct research and investigate forward and downward looking, acoustic to seismic, landmine detection techniques and conduct modeling and data collection that will facilitate a better understanding of the phenomenology associated with these two applications. No additional funding is required to complete this project.	0	1338	0	0
Off Route Mine Detection and Neutralization: In FY02 and FY 03, this program will research and investigate technologies that will provide the warfighter new detection capabilities against the threats of off-route/side attack mines, booby traps, anti-helicopter mines, and improvised explosive devices through the exploitation of their distinctive signatures in the short wave infrared region and acoustic resonance. In FY 04, investigate threat negation through standoff circumferential RF jamming/neutralization technologies on the host vehicle. In FY05, continue to research and conduct evaluation of off route detection capabilities designed to provide FCS with increased OPTEMPO for both vehicle and soldier survivability.	2306	2205	3910	3856
Acoustic Mine Detection: In FY02 and FY03, this two-year Congressional Add will research and investigate phenomenology of linear/non-linear acoustics combined with ground penetrating radar for mine detection in downward and forward looking modes of AT mines in roads.	1922	3156	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602712A - Countermines Systems

PROJECT
H24

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Countermines Phenomenology: In FY04 conduct research and investigations to model, characterize, and predict the effects of the environmental, surface, and shallow subsurface conditions on sensor response and signal interpretation. In FY 05, an investigation of clutter encountered with various sensor modalities will be used to predict and reduce false alarms.	0	0	2943	3906
Integrated CM Test-bed & Training: This one year Congressional add researched neutralization and robotic technologies for detection of anti-personnel/anti-tank landmines. No additional funding was required to complete this project	1343	0	0	0
Standoff Mine Detection: This one year Congressional add researched forward looking ground penetrating radar sensor technologies for detection of anti-personnel/anti-tank landmines. No additional funding was required to complete this project.	1946	0	0	0
Landmine Detection/Seismic Energy: This one year Congressional add researched novel seismic sensor technologies for detection of anti-personnel/anti-tank landmines. No additional funding was required to complete this project.	960	0	0	0
Totals	19733	14440	18648	18687

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602712A - Countermine Systems						PROJECT H35	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H35 CAMOUFLAGE & COUNTER-RECON TECH	2262	2417	2643	2735	2830	2881	2945	3012

A. Mission Description and Budget Item Justification: This project researches and investigates advanced signature management and deception technologies for masking friendly force capabilities and intentions, thereby increasing Objective Force unit survivability. Specific research areas include (1) advanced materials and processes for countering visual, infrared (IR), and spectral sensors, (2) optical and electronic techniques for reducing the signatures of uncooled IR sensors used in FCS/Objective Force, (3) modeling and simulation of the vulnerability of sensors to laser blinding, and (4) new technologies to exploit or deny the enemy's use of reconnaissance sensors against Objective Force. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP). No Defense Emergency Funds (DERF) were provided to the project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Advanced Signature Management & Deception: Completed development of a signature management camouflage net that utilizes advanced coatings and deception techniques, and evaluated survivability improvements from the new technologies. The warfighting payoff will be a significant increase in survivability due to reduction in IR signature (> 30% reduction in the short wave infrared (SWIR) band), as supported by field demonstrations and simulations using Combined Arms and Support Task Force Evaluation Model (CASTFOREM) and the Paint the Night synthetic sensor simulation.	2262	0	0	0
Low Cost Counter Reconnaissance Technology: This effort develops new technologies to counter threat reconnaissance capabilities and to reduce the laser susceptibility of our own sensors, provides susceptibility data for countermeasure systems, and extends camouflage paint technology for hyper-spectral threats. The critical technologies developed will include low cost measures to defeat advanced surveillance sensors such as hyper-spectral imagers and measures to reduce the signature of uncooled IR sensors. In FY 03, select uncooled IR cameras and analyze their signature characteristics, determine the primary spectral sensing bands that threaten Objective Force assets. In FY04, fabricate new reduced signature uncooled IR focal plane arrays (FPAs), determine the laser vulnerabilities of advanced uncooled IR sensors. In FY05, integrate new FPAs and optics into a prototype hardened, uncooled IR sensor and fabricate advanced paints and patterns incorporating spectral signature reduction.	0	2417	2643	2735

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602712A - Countermine Systems

PROJECT
H35

Accomplishments/Planned Program (continued)

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Totals	2262	2417	2643	2735

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	20144	20516	16749	16357	17676	18193	18331	18753
H34 RURAL HEALTH TECH	2398	0	0	0	0	0	0	0
H70 HUMAN FACT ENG SYS DEV	17746	17180	16749	16357	17676	18193	18331	18753
J20 OMNI DIRECTIONAL TREADMILL UPGRADE	0	3336	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The primary objectives of this program are to maximize the effectiveness of soldiers in concert with their materiel so that they may survive and prevail on the battlefield in the context of the Army Transformation to the Objective Force. 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 Congressionally directed program on Rural Health Technology focused on the researching, field testing, and empirical validation of methods for improving the coordinated functioning of civilian and military emergency medical teams. A FY03 Congressionally directed program for the Omni Directional Treadmill upgrades focuses on designing and developing a state-of-the-art omni directional treadmill to support research studies in virtual environments to support Objective Force Warrior. 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 0603001 (Warfighter Advanced Technology), and PE 0603005 (Combat Vehicle and Automotive Technology). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	19791	17415	17132	17607
Current Budget (FY 2004/2005 PB)	20144	20516	16749	16357
Total Adjustments	353	3101	-383	-1250
Congressional program reductions				
Congressional rescissions		-2239		
Congressional increases		5600		
Reprogrammings	512	-118		
SBIR/STTR Transfer	-159	-142		
Adjustments to Budget Years			-383	-1250

FY03 Congressional Adds:
 Omni Direction Treadmill Upgrade, Project J20 (\$3500); MANPRINT Modeling, Project H70 (\$2100)

Projects with no R-2A:

(\$3452)Omni Direction Treadmill Upgrade, Project J20: The objective of this one-year Congressional Add is to provide technology to upgrade the Omni Directional Treadmill. The Omni-Directional Treadmill is a device that infantry soldiers use to move (crawl, walk, run) through a virtual environment. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
**0602716A - HUMAN FACTORS ENGINEERING
 TECHNOLOGY**

PROJECT
H70

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H70 HUMAN FACT ENG SYS DEV	17746	17180	16749	16357	17676	18193	18331	18753

A. Mission Description and Budget Item Justification: The goal of this program is to maximize the effectiveness of soldiers in concert with their equipment, in order to survive and prevail on the battlefield in the context of the Army Transformation to the Objective Force. 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. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602716A - HUMAN FACTORS ENGINEERING
TECHNOLOGY

PROJECT
H70

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- Identify metrics to optimize information flow, workload and skill requirements of command and control processes and how commanders and staffs make decisions at all echelons. In FY02, two C2 training tools were transitioned to the Command and General Staff College (CGSC), the School of Command Preparation (SCP), the Depth and Simultaneous Attack Battle Lab (D&SA BL), the National Guard, and Forces Command (FORSCOM). The Command, Control, and Communications Tactically Relevant Assessment of Combat Execution (C3 TRACE) modeling tool results were used to guide and validate soldier-in-the-loop Battle Lab experiments and to provide criteria to evaluate FCS concept proposals. In FY03, model Future Combat System (FCS) and Objective Force Warrior (OFW) information flow, decision-making and collaboration to evaluate operational concepts. In FY04, mature a suite of command and control (C2) tools for Objective Force commanders, leaders, and soldiers to employ during close combat in complex and urban terrain. In FY05, provide baseline C2 tools to TRADOC schools. These tools will allow for collaborative and distributed decision making with the objective of improving performance under time, combat, fatigue, and workload stressor conditions.</p>	4584	3700	4078	4062
<p>- Develop human performance modeling tools to optimize soldier machine interactions for Objective Force Warrior and FCS. In FY02, modeled function allocation for FCS (Line of Sight - Beyond Line of Sight vehicle) crew using the IMPRINT human performance-modeling tool, and examined the effects of interocular sensor separation on terrain-hazard detection and braking distance, improving driver's ability to negotiate roads, trails, or paths at night or under reduced visibility. In FY03, create a digital library of individual soldier equipment to use in modeling FCS and OFW and evaluate soldier perceptual performance when operating in an urban environment. In FY04, link vehicle dynamics, biodynamics, and anthropometric modeling capabilities and apply the hearing hazard model to firing weapons in hazardous environments such as MOUT enclosures and tunnels to specific hearing protection requirements. In FY05, provide user-accessible soldier-centered tools, models and expertise to combat and materiel developers so that the full range of soldier cognitive and task performance can be considered in a cost-effective manner in all phases of acquisition.</p>	2555	2266	2556	2500

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602716A - HUMAN FACTORS ENGINEERING
TECHNOLOGY

PROJECT
H70

Accomplishments/Planned Program (continued)

- Increase soldier performance while conducting operations on-the-move. Validate and recommend methods to mitigate soldier performance degradation due to motion sickness induced by noise, vibration, vehicle movement and confinement during operations-on-the-move. Determine soldier requirements for multi-modal information presentation, the interaction of physical & cognitive loading and its impact on situational awareness and performance. Expand model to include motion tolerance effects of on-the-move mission planning and rehearsal for the mounted and dismounted OFW. In FY02, conducted follow-on studies investigating operations-on-the-move impact on soldier performance using the ride motion simulator and Stryker armored vehicle and provided results to the Lead System Integrator (LSI) and PM for FCS, established Human Dimension IPT to support Phase I of FCS in order to include soldier performance considerations in analyses, modeling, simulation, and testing, and conducted initial studies to address increased cognitive load and information availability and management on dismounted teams and soldier mission performance and provided results to Natick Soldier Center. In FY03, support PM FCS during development of the Phase II program and investigate the ability of soldiers to control a semi autonomous moving platform from an encapsulated, dynamic environment. In FY04, evaluate new head-mounted displays, cognitive decision aids and driving aids concepts for Block II FCS, and conduct situational understanding studies to validate modeling results. In FY05, field validate and provide recommendations on warrior interface design specifications for C4ISR systems to PM OFW and FCS.

FY 2002	FY 2003	FY 2004	FY 2005
5048	6534	3410	3095

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602716A - HUMAN FACTORS ENGINEERING
TECHNOLOGY

PROJECT
H70

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- In FY02, conducted broad-based program of research directed toward optimizing soldier performance and soldier-machine interactions to maximize battlefield effectiveness and reduce operations and sustainment costs. In FY03, provide lead on Human Factors Engineering (HFE) and MANPRINT support to Training and Doctrine Command (TRADOC) Centers and Schools, Battlelabs, Army Materiel Command (AMC), AMC Research Development and Engineering Centers (RDEC)s, Army Test and Evaluation Command (ATEC) and other service laboratories. In FY04, establish parameters of human-robot interaction research on effects of incorporating robot telepresence on soldier situation awareness; develop concept of "context sensitivity," including how best to provide the operator with a compressed history of the robot's (or robot swarm) environment for the period leading up to its spotting a cue, an unknown, or its getting stuck. In FY05, broaden the concepts to incorporate humans-in-automation UGV issues such as "automation environment cognitive task-shifting requirements" of autonomous and semi-autonomous robots providing combat information under often unexpected schedules; soldier-robot team interaction issues including mixed-initiative executive control; and span of control enhancements (number of operators vs number of robots).	4559	2580	2705	2700
-In FY04, determine optimal allocation of tasks to soldier and automation for control of unmanned systems. In FY05, validate allocation of tasks to soldiers and automation for control of unmanned systems.	0	0	4000	4000
-MANPRINT Modeling: This one year congressional add will focus on developing human performance modeling tools and associated databases for the Objective Force Warrior and FCS. No additional funding is required to complete this project.	0	2100	0	0
- Soldier Centered Design Tools: This one-year congressional add allowed Soldier-specific design constraints to be evaluated in the design process of materiel acquisition. In FY02, improved the tools connectivity with other models, reduced analysis turnaround time, improved representation of training effect on soldier performance, reduced cost to model performance under extreme environments, and increased flexibility to model novel maintenance and support concepts. No additional funding is required to complete this project.	1000	0	0	0
Totals	17746	17180	16749	16357

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602720A - Environmental Quality Technology

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	16692	26747	18252	17157	18035	20467	20228	19600
048 IND OPER POLL CTRL TEC	1256	2587	3837	4203	3420	3484	3541	3625
835 MIL MED ENVIRON CRIT	2196	2936	3277	3626	3738	3809	3888	3978
895 POLLUTION PREVENTION	0	0	0	1189	3631	6343	5888	5885
896 BASE FAC ENVIRON QUAL	2757	7000	9157	8139	7246	6831	6911	6112
EM1 WASTE MINIMIZATION AND POLLUTION RESEARCH	1919	0	0	0	0	0	0	0
EN8 MOLECULAR & COMPUTATIONAL RISK ASSESSMENT	1343	0	0	0	0	0	0	0
F25 MIL ENV RESTOR TECH	3101	8885	1981	0	0	0	0	0
F28 RANGE SAFETY TECH DEMO	4120	2003	0	0	0	0	0	0
F39 ENVIRONMENTAL RESPONSE & SECURITY PROTECTION PROG	0	3336	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 regulations mandated by all Federal, state and local environmental/health laws and to reduce the cost of this compliance. The program element investments provide the Army with a capability 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 element develops pollution control technology, which assists installations in complying with environmental regulations at less cost. The program element also provides technology to mitigate noise impacts and maneuver area damage resulting from Army training activities. The work in this program element is aligned with the Army's vision for the Objective Force and adheres to Defense Reliance Agreements on civil engineering and environmental quality with oversight provided by the Joint Engineers and Armed Services Biomedical Research Evaluation and Management. The cited work is also consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center and the U.S. Army Armament Research, Development and Engineering Center (ARDEC). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602720A - Environmental Quality Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	23569	23018	25521	26860
Current Budget (FY 2004/2005 PB)	16692	26747	18252	17157
Total Adjustments	-6877	3729	-7269	-9703
Congressional program reductions				
Congressional rescissions		-1191		
Congressional increases		5600		
Reprogrammings	-6347	-153		
SBIR/STTR Transfer	-530	-527		
Adjustments to Budget Years			-7269	-9703

Change Summary Explanation: Funding – FY 2004/2005: Funds realigned to PE 63728, Project 03E to accelerate environmental restoration technology development.

FY03 Congressional Adds:

Rangesafe, Project F28 (\$2100); Environmental Response and Security Protection, Project F39 (\$3500).

Projects with no R-2As:

- (\$2100) Rangesafe, Project F28: The objective of this Congressional Add is to develop and evaluate technologies for remediation of Army firing ranges. No additional funding is required to complete this project.

- (\$3500) Environmental Response and Security Protection, Project F39: The objective 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.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A - Environmental Quality Technology						PROJECT 048	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
048 IND OPER POLL CTRL TEC	1256	2587	3837	4203	3420	3484	3541	3625

A. Mission Description and Budget Item Justification: This project provides applied research and technologies to enable the Army to reduce or eliminate the effects of legal and regulatory environmental restrictions, as well as to avoid fines and facility shutdowns. These new 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 due to Army Transformation. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force Transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602720A - Environmental Quality Technology

PROJECT
048

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Installation Operations - In FY02, determined physical and chemical interactions between selected energetic materials and building materials under long-term exposure situations to prevent contamination and minimize hazardous waste. In FY03, formulate protocol for energetic compound biological treatment of munitions production wastewater under anaerobic conditions leading to more cost effective compliance with effluent environmental quality standards. In FY04, determine 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 to reduce disposal costs, protect human health and the environment and maintain sustainable installations. In FY05, formulate an automated decision support system for environmental management system implementation that Army installations can use in complying with national and regional environmental regulations. Mature physiochemical and biosorbent treatment technologies for wastewater from munitions production allowing cost effective treatment while maintaining mission readiness. Identify and develop alternative technologies and processes to improve solid waste management and reduce operational, logistical, and environmental requirements for deployed troops.</p>	748	1914	2478	2675
<p>Land Planning and Management/Sustainable Live-Fire Range Design and Maintenance – In FY02, identified range load and condition durability factors associated with environmental compliance. In FY03, complete first order range risk assessment framework with mission impact identification factors. In FY04, develop a risk assessment quantification methodology to evaluate level of environmental risk related to training range designs. In FY05, prepare an engineering analysis of costs, effectiveness, and life-cycle operations and maintenance requirements of environmentally compliant range designs to reduce and facilitate maintenance, cleanup (munitions and scrap), and erosion control. Training and Test Range Noise Control – In FY02, updated Small Arms Range Noise Assessment Model and Blast Noise impact assessment software to improve capability to forecast training noise impacts. In FY03, improve weapons acoustic source information for model input. In FY04, improve 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.</p>	508	673	1359	1528
Totals	1256	2587	3837	4203

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A - Environmental Quality Technology						PROJECT 835	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
835 MIL MED ENVIRON CRIT	2196	2936	3277	3626	3738	3809	3888	3978

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 and field operations or disposed of through past activities. The end results of this research are determinations of acceptable residual concentration levels that will protect the environment and human health from adverse effects. The main product of this research is the Army Risk Assessment and Modeling System (ARAMS). This PC-based platform links models of fate and transport to the exposure and effects models and databases of explosives and their degradation by-products. This reduces the uncertainty associated with both the probability of exposure and the ultimate effect if exposed. Interim products are U.S. Environmental Protection Agency approved health advisories and criteria documents to be used in risk assessment procedures. The Army uses these criteria during negotiations with regulatory officials to set scientifically and economically rational safe cleanup and discharge levels at Army installations. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Center for Health Promotion and Preventive Medicine (CHPPM), and the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602720A - Environmental Quality Technology

PROJECT
835

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Land Remediation/Hazard/Risk Assessment Tools for Military Unique Compounds – In FY02, constructed the framework of a rigorous ARAMS to seamlessly link models of exposure/effects with toxicological data for military relevant contaminants. In FY03, determine exposure assessment process descriptors for migration of unexploded ordnance (UXO) constituents, explosives, propellants, smokes, and illuminants to improve fate and transport components of ARAMS. Provide high quality toxicological data for the contaminants of concern for integration into ARAMS to expand applicability of models. Distributed Source Contamination on Army Ranges – In FY04, determine exposure assessment process descriptors for migration of UXO constituents, explosives, propellants, smokes, and illuminants. In FY05, integrate acceptable environmental endpoints into ARAMS for use in estimating environmentally protective cleanup requirements. Long Term Monitoring for Army Ranges – In FY04, generate a compendium of analytical methods applicable to military contaminants and establish the scientific basis for real-time in situ monitoring systems. 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.</p>	2196	2936	3277	3626
Totals	2196	2936	3277	3626

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A - Environmental Quality Technology	PROJECT 895						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
895 POLLUTION PREVENTION	0	0	0	1189	3631	6343	5888	5885

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 developed 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 the DoD High-Performance Computing network; 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 work is performed by the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD and provides required technologies for advanced development programs at the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ, the Edgewood Biological and Chemical Center, Aberdeen Proving Ground Edgewood Area, MD, and the Aviation and Missile Research, Development and Engineering Center, (AMRDEC), Huntsville, AL. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The project contains no duplication with any effort within the Military Departments. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Pollution Prevention - In FY05, mature environmentally benign additives for gun propellants and microbial additives to rapidly degrade unexploded ordnance (UXO). Mature non-polluting, low toxicity rocket missile propellants.	0	0	0	1189
Totals	0	0	0	1189

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A - Environmental Quality Technology						PROJECT 896	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
896 BASE FAC ENVIRON QUAL	2757	7000	9157	8139	7246	6831	6911	6112

A. Mission Description and Budget Item Justification: The objective of this project is to provide environmental assessment, monitoring, and modeling technologies to support sustainable use of the Army's training facilities, lands, firing ranges, and airspace to reduce or eliminate environmental restrictions on military uses. The Army will have 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 force transformation, and to support the Objective 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 the use of those resources to mission and environmental compliance. It will also provide advanced methods to restore lands damaged during training activities. Technologies will allow operation and maintenance of installation facilities and training range resources, complying with the many environmental requirements without interrupting operations or training activities. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Threatened and Endangered Species (TES) Management to Reduce Operational Constraints – In FY03, complete cost-effective, Army-wide inventory of TES and identified monitoring techniques for high priority TES. Establish methodological and statistical protocols for determination of endangered species population viability to prevent training restrictions. In FY04, expand impact assessment protocols developed for the Red-cockaded Woodpecker to examine habitat impacts from land management practices. In FY05, complete analysis of effects of military training and land management on high priority TES species to support reduction/elimination of training restrictions.	0	2940	3265	3565
Predictive Risk Assessment and Management for Army Ranges and Training Lands – In FY03, evaluate range design, construction, and maintenance requirements against current and future environmental compliance requirements. In FY04, complete a risk assessment matrix that identifies environmental compliance risks to ranges and incorporates approaches for mitigation of risks. In FY05, develop design criteria and operation and maintenance criteria for sustainable ranges that incorporate environmental compliance considerations.	0	2030	2648	1587

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602720A - Environmental Quality Technology

PROJECT
896

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>Land Planning and Management – In FY02, developed geospatial modeling environment to integrate military mission and resource impact assessment tools. In FY03, complete noise source characterization protocols and initial human response characterization to assess noise impact of operations. Develop Army Training and Testing Area Carrying Capacity (ATTACC) protocols that incorporate scientific improvements in wind erosion and soil compaction factors. In FY04, develop particulate matter emission estimation models for tactical vehicle engines and chemical/physical particulate matter control technologies for unpaved surfaces. Link 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 sustainment. Provide tools that will improve erosion control practices and prioritization of sites for land rehabilitation in support of sustainable training lands.</p>	1521	1820	3019	2987
<p>Installation Operations/Hazardous Air Pollutants (HAP) – In FY02, developed activated carbon absorber system for cost-effective solvent recovery from cleaning and chemical stripping operations. In FY03, develop integrated strategies to control emissions from combustion sources. In FY04, develop technologies for controlling and/or recycling chlorinated solvents from vehicle manufacturing and rework sources.</p>	1236	210	225	0
Totals	2757	7000	9157	8139

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A - Environmental Quality Technology						PROJECT F25	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
F25 MIL ENV RESTOR TECH	3101	8885	1981	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this project is to provide cost effective technologies required to clean up Department of Defense (DoD) hazardous waste sites, including active installations under the Installation Restoration Program, those indicated for closure under the DoD Base Realignment and Closure Program and the Formerly Used Defense Sites Program. Technologies focus on cost-effective and efficient remediation of active training ranges that support enhanced readiness for the Objective Force. The thrust of this effort is to expedite site cleanup, reduce the cost of cleanup of contaminated soil, groundwater, and structures, and ensure that human health and the environment are protected. Research is conducted in several major areas: innovative and cost-effective site identification, characterization, and monitoring technologies, groundwater systems; and treatment technologies to remediate soil and groundwater contaminated with military-unique contaminants such as explosives/energetics, chemical agents, heavy metals, and other organics. Emphasis is placed on the development of in-situ remediation technologies and real or near real-time sensing technologies for Unexploded Ordnance (UXO). Development of existing technologies provides near-term solutions while adding to the knowledge base applicable to successful development of more complex in-situ technologies. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Unexploded Ordnance (UXO) Identification and Discrimination - In FY02, developed advanced multi-sensor prototypes and data analysis technologies for false alarm reduction. Validated UXO signature models for emerging sensors. Validated UXO sensing and analysis technologies in standard UXO test sites. In FY03, develop optimum site characterization protocols for UXO sites. Construct advanced UXO sensor fusion analysis algorithms to apply to developing UXO detection/discrimination capabilities.	1713	1958	0	0
Hazard/Risk Assessment Tools for Military Unique Compounds - In FY02, completed Army Risk Assessment Modeling System (ARAMS) version 1.0 for risk based assessment. In FY03, integrate predictive exposure and effects models with toxicity databases to determine exposure and toxicity indexes of explosives, propellants, smokes and illuminants.	809	612	0	0

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602720A - Environmental Quality Technology

PROJECT
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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
In Situ Remediation Technologies for Contaminated Groundwater and Soils - In FY02, demonstrated in the laboratory in situ heavy metals extraction from soils and in situ chemical/biological treatment for TNT/RDX, and developed a protocol for in situ remediation of RDX in groundwater. In FY03, mature processes for recycling metal contaminated extracts for soils treatment systems. Perform pilot-scale evaluation of in situ biodegradation for TNT and in situ reactive barriers and/or reactive barriers coupled with biodegradation for explosives in groundwater. In FY04, complete pilot-scale evaluation of in situ biodegradation for TNT and of advanced electro-kinetic treatment technologies for lead contaminants.	579	3144	1411	0
Characterization, Evaluation and Remediation of Distributed Source Contamination on Army Ranges - In FY03, conduct integrated assessment and evaluation of distributed source contamination on live fire training ranges. Quantify and evaluate predictive models for distributed source contamination on live fire training ranges in the laboratory. In FY04, adapt hazardous waste site restoration processes and techniques for application to distributed contamination sources on live fire ranges.	0	1951	570	0
Military Impacts on Threatened and Endangered Species and Land Planning and Utilization for Army Ranges - In FY03, determine military impacts on six priority Threatened and Endangered Species and improve Army Training and Testing Area Capacity protocols.	0	1220	0	0
Totals	3101	8885	1981	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602782A - Command, Control, Communications Technology

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	22130	21150	18728	18696	19816	20105	21387	22138
779 C2 & PLAT ELEC TECH	7645	9221	8006	8367	9364	9862	10327	10791
H92 COMMUNICATIONS TECH	14485	11929	10722	10329	10452	10243	11060	11347

A. Mission Description and Budget Item Justification: Communications and Command & Control technologies must continue to advance in order to realize the changes in operations and doctrine anticipated for the FCS Objective Force. This program element (PE) researches advanced communications technologies and expands scientific knowledge of command and control (C2), and electronics systems/subsystems. 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. Research includes the investigation of 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, network-centric battlefield environment. This PE will provide technologies that allow Objective Force field commanders to communicate on-the-move (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 Objective Force to achieve overmatch with agility and versatility. In addition, portions of the research are directed to supporting the Joint Tactical Radio System (JTRS) evolutions. The cited work is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. Work in this PE is related to and fully coordinated with efforts in PE 0603006A (Space Applications Advanced Technology), PE 0603008A (Command, Control and Communications Advanced Technology), PE 0602783A (Computer and Software Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), PE 0603734A (Military Engineering Advanced Technology), and PE 62705 (Electronics & Electronics Technology). The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command, Fort Monmouth, NJ. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602782A - Command, Control, Communications Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	24123	21821	22349	23519
Current Budget (FY 2004/2005 PB)	22130	21150	18728	18696
Total Adjustments	-1993	-671	-3621	-4823
Congressional program reductions				
Congressional rescissions		-1857		
Congressional increases		1500		
Reprogrammings	-1610	-121		
SBIR/STTR Transfer	-383	-193		
Adjustments to Budget Years			-3621	-4823

Change Summary Explanation: Funding – FY 2004/2005: Funds realigned to higher priority requirements.

FY03 Congressional Adds:

Mobile Emergency Broadband System, Project H92 (\$1500)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
**0602782A - Command, Control, Communications
 Technology**

PROJECT
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COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
779 C2 & PLAT ELEC TECH	7645	9221	8006	8367	9364	9862	10327	10791

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 Objective Force. The Objective 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 enables commanders at all echelons to have better and more timely information and allows them to command from anywhere on the battlefield, freed from their command posts and while on-the-move. 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 Agile Commander Advanced Technology Demonstration (ATD) matures digital hardware and software technologies that provide agile, rapidly deployable, split-based C2 operations. The Information Warfare Protect and Attack program provides a modeling and simulation/stimulation environment for man-in-the-loop evaluation and warfighter training for network protection. The Networked Sensors for the Objective Force ATD will model a lower echelon C2 information infrastructure to optimize information flow between dispersed C2 nodes and a series of unmanned platforms. The Battle Space Tactical Navigation program will mature technology and integration concepts that improve the robustness of navigation systems and minimize registration errors between sensors and databases. The Soldier/Squad Level Communications effort matures tactically mobile and lightweight C2 subsystems and applications to enable dismounted tactical commanders at brigade and below to achieve information dominance and precision maneuver. This project supports the Objective Force transition path of Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

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Technology

PROJECT
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Battle Space Awareness & Positioning: In FY02, conducted lab test to determine the benefit of GPS anti-jam, GPS pseudolite and navigation/electro-optic system integration technologies. Conducted a distributed simulation at the Training & Doctrine Command (TRADOC) Analysis Center, Fort Leavenworth, KS using live troops and multiple sites to assess the quality of the simulation and improve model performance. Investigated C2 applications at battalion to squad levels for a mobile software agent situational awareness subsystem, including distributed battle planning and visualization, decision support aids, and human-machine interfaces through enhanced speech recognition. In FY03, conduct a field test with DARPA to evaluate GPS direct P(Y) acquisition and GPS pseudolite aiding in a high electronic counter measures/jamming environment. Conduct laboratory tests for limited speech recognition, intelligent software agents for alerts, and collaborate planning. In FY04, identify suitable emerging low power timekeeping technology; characterize ultra-wide band transmission through terrain and walls for position location; an architecture for network assisted GPS receivers for the military code; investigate modeling and simulation capability to evaluate enhanced dead-reckoning sensor technology and body motion models, define necessary battle language management and graphical concept representation construct interfaces; instrument visualization display mechanisms. Demonstrate in an operational environment speech recognition capabilities within a wearable computer platform and distributed wireless environment with voice-controlled applications. In FY05, design, breadboard, and conduct technical tests and evaluations a low power time-keeping device; investigate sensitivity enhancements for ultra-wide band navigation/identification tags to achieve a 10 times range extension; design a network assisted GPS receiver; select sensor technologies for a low cost dead-reckoning device.</p>	2850	2983	3142	3418

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602782A - Command, Control, Communications
Technology

PROJECT
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	FY 2002	FY 2003	FY 2004	FY 2005
<p><u>Accomplishments/Planned Program (continued)</u></p> <p>C2 On-The-Move Enabling Technologies: This effort investigates technologies that enable course of action (COA) generation and analysis. In FY02, investigated a task expansion engine as a component within distributed analysis and visualization tool set for C4I to provide low level detail and synchronization data within a COA. Matured intelligent agents to enable linkage of different intelligent agents by action officers and end-users to provide enhanced C2 capabilities. Matured proper provisioning and filtering of information to support the commander in the decision making process. In FY03, expand and evaluate a robust tool set optimized for the commander and staff informational needs, capable of operating in a distributed environment, using a variety of structured and unstructured data sources; investigate bi-directional links between these tools, intelligent agents, and other analytical or course of action tools to provide an integrated tool suite for the command and staff. Complete on-going technology efforts and transition and integrate products and concepts into the Distributed Analysis Visualization Infrastructure for C4I (DaVinci) tool set. Create detailed design plan and C2 data framework/protocol design to test automated, knowledge-based capabilities enabling critical C2 situation awareness information retrieval and assessment and presentation in a manner that enhances the commander's ability to use remote unattended sensors and unmanned system assets. In FY04, investigate and evaluate the C2 data framework/protocol through low fidelity modeling and simulation, leverage ARL and DARPA robotic technologies, and mature C2 applications to enable systems management of these robotic elements. In FY05, integrate C2 data framework / protocol into a rudimentary C2 system and test it against a representation of unmanned networked sensors,model C2 applications to task sensor assets, receive a fused "Red" picture and network effects.</p>	4310	5756	4298	4285
- Airborne Engineering Support: Conduct flight test evaluation for C4IEW systems.	485	482	566	664
Totals	7645	9221	8006	8367

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A - Command, Control, Communications Technology					PROJECT H92			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H92 COMMUNICATIONS TECH	14485	11929	10722	10329	10452	10243	11060	11347	

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 Objective Force, including the dismounted soldier. The strategy is based on leveraging and adapting commercial technology to the maximum extent possible and focusing research efforts on those areas not addressed elsewhere (e.g. mobile radio based infrastructures, security in narrowband environments, multiband on-the-move (OTM) transmit and receive antennas, adaptive protocols and low probability of interception/low probability of detection). The main effort of this project concentrates on Dynamic Readdressing and Management (DRAMA), Advanced Antennas, C4ISR OTM Demo, Soldier/Squad Level Communications, Networked Sensors for the Objective Force (NSfOF), and Free space Optical /Near-Optical Communications Systems (FOCUS). These programs focus on key areas of research include: Mobile wireless technologies for hostile mobile environments (FOCUS), and to meet the size, weight and power needs of the individual dismounted soldier (Soldier/Squad Level Comms); quality of service techniques that enable efficient, automatic bandwidth management for mobile, wireless networks (DRAMA); open systems designs for wideband networking waveforms; and mobile internet protocols operating across different networks; networking technologies that support unattended sensors with the ability to task unmanned sensors and transport data and images from them to data fusion points and tactical commanders(NSfOF Comms); research realistic models for emerging communications systems in dynamic field environments and network protection technologies. It leverages a variety of efforts including the DARPA Sensor Information Technology (SensIT) program as well as technologies developed by Army Research Laboratory. In addition, this project investigates tactical antenna technologies to reduce the number required, and increase the range and throughput; Ferroelectric materials for reduced cost wideband on-the-move phased array antennas; and technology to increase survivability by reducing the antenna visual signature. In FY02, this project also investigated technology to support C3 OTM Demo (63008/TR2), which provides early and continuing demonstrations of enhanced survivability and lethality of Future Combat Systems (FCS) platforms through the effective employment of an integrated C4ISR On-the-Move system.

This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602782A - Command, Control, Communications
Technology

PROJECT
H92

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Dynamic Readdressing and Management (DRAMA) – This effort investigates advanced networking protocols and management enabling robust on the move communications. In FY02, matured initial dynamic addressing protocols and network management software leading to the Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) interim demo. Designed, implemented, and performed laboratory evaluation of an Artificial-Intelligence (AI) based fault isolation decision aid system to inter-operate with mobile agents, resulting in more efficient network management capability. Enhanced fault isolation decision aid system for incorporation into C4ISR OTM demo to mitigate risk for FCS milestone B decision. In FY03, investigate dynamic addressing and IP multicast protocols, investigate Automated Net Management software to include on-the-move network components. In FY04, investigate intelligent agents and mobile agents software to operate with wireless OTM tactical network components. In FY05, investigate enhanced Automated Net Management tools to include integration with net management agents, enhance Intelligent agents and mobile agents to operate in wireless OTM tactical network environment, and scalability of dynamic readdressing and IP multicast protocols in large tactical OTM networks. 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.</p>	2685	3677	4334	7229

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602782A - Command, Control, Communications
Technology

PROJECT
H92

Accomplishments/Planned Program (continued)

Advanced Antennas: In FY02 matured a low cost controller architecture for OTM multi-beam phased array antenna and investigated new controller tracking algorithms and a low cost antenna pointing system. This capability will enable automatic positioning of the antenna's beams on the intended satellite systems regardless of the vehicle's speed or position. In FY03, investigate low profile antennas for ground/rotary wing aviation platforms leveraging component technologies from conformal body borne antenna efforts to provide low observable antennas covering the 30-200MHz communication bands. Investigate the radio frequency (RF) radiation hazard safety assessments for the conformal body borne vest and helmet antennas to determine specific absorption rates (SAR) and safety compliance levels. In FY04, enhance and modify the modeling algorithms for Advanced Antennas to assess antenna design to include the body borne, low profile and multiband antennas, platform antenna placement, cosite interference mitigation, and complete human RF Safety Assessment. In FY05, investigate technologies for the Multi-beam Phased Array antenna to enable multi-mission simultaneous communications with the Global Broadcast System (GBS), Wide-band Gapfiller and MILSTAR satellite systems while on-the-move. Investigate technologies for a family of Rotary Wing Aircraft multi-band antennas, lightweight body borne antennas (helmet and vest), and low cost reconfigurable band switched antennas to comply with JTRS communications requirements for various ground and air platforms.

FY 2002	FY 2003	FY 2004	FY 2005
1400	2500	2167	1000

C4ISR OTM Demo - Conducted a technology selection across CERDEC, AMRDEC, ARDEC and DARPA programs. Matured integrated software (S/W), hardware (H/W), communication, and sensor architectures including 1.) Baseline wireless communication network (LAN / Voice) for the On-The-Move test-bed 2). Baseline Command and Control (C2) architecture for the OTM Test-bed. Integrated LSI input into the H/W, S/W and communications architectures.

5898	0	0	0
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Soldier/Squad Level Communications: In FY02, Investigated and designed a SUO SAS modeled waveform for tactical radio communications in laboratory environment. In FY03, conduct performance trade-off and affordability analyses for Small Unit Operations Situational Awareness System (SUO SAS) tactical radio communications leading to a communications reference architecture supporting hardware and software portability to JTRS. In FY04, mature and integrate a scaleable (multi-band, multi-channel) RF front-end and programmable radio modem and link-layer intranet processor, Wideband Networking Waveform (WNN) hardware and software components with JTRS-compliant application programming interfaces.

1875	2600	788	0
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602782A - Command, Control, Communications
Technology

PROJECT
H92

	FY 2002	FY 2003	FY 2004	FY 2005
<p><u>Accomplishments/Planned Program (continued)</u></p> <p>Free Space Optical/Near-Optical Communications (FOCUS) and Sensors Networking: In FY02, investigated sensor communications breadboard models in a limited (20 node) network with anti-jam (AJ), low probability of intercept (LPI), low probability of detection (LPD) and secure modes. Investigated adaptive optics based on 1.5 um Wavelength Division Multiplexing (WDM) system and topology control, CONOPS model based on ground/airborne links. Linked model incorporating adaptive optics, and commenced model architecture for tracking hardware for free space optical communications system. Performed limited integration of internet protocol quality of service and security into MOSAIC systems architecture. In FY03, extend FCS architecture to include maneuver layer interoperability to sensor communication relays and gateways under the Networked sensor for Objective Force (NSfOF) effort, investigate Comm-Node Effort for Terrestrial/Airborne System and investigate limited tracking using modulating retroreflector. Investigate advanced wireless network access control technologies. In FY04, refine sensor communications requirements; integrate protocols and waveforms into model hardware, commence design of subsystem including transmitter laser, tracking hardware, down conversion (extract data from laser) unit for FOCUS. In FY05, conduct early laboratory experiments to establish performance against program goals and evaluation criteria for NSfOF, and conduct laboratory demonstration emphasizing subsystem investigation for FOCUS.</p>	2627	1745	3433	2100
<p>Mobile Emergency Broadband System: The purpose of this one year congressional add is to investigate emerging wireless technology to enable rapidly deployable voice and data communications for connectivity between emergency personnel in the "hot zone" and to the command center. No additional funds are required to complete this project.</p>	0	1407	0	0
Totals	14485	11929	10722	10329

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602783A - COMPUTER AND SOFTWARE TECHNOLOGY					PROJECT Y10			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
Y10 COMPUTER/INFO SCI TECH	3895	4001	4142	4102	3788	3878	3947	4027	

A. Mission Description and Budget Item Justification: This program investigates and matures command, control, communications (C3) software and components to increase Future Combat System (FCS) and Objective Force lethality and survivability through improved commanders decision making and situational awareness. The goal of this program element is two-fold: 1) To automate the collaboration for decision making (planning and execution) so that it is synchronized, parallel and real time, and 2) to develop collaboration tools to support both the staff and the Commander. Challenges for this program include automated tools to support the flow and synchronization of 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. 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 Objective Force. Focus is on providing widely applicable solutions that can be applied across the spectrum of command and control (C2) problems. 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). Work in this project is conducted by the U.S. Army Research Laboratory, and is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602783A - COMPUTER AND SOFTWARE
TECHNOLOGY

PROJECT
Y10

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- 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 FY02, evaluated and refined collaborative planning tools in support of evolving Objective Force command and control process; conducted experiments and documented the usability of the tools at Training and Doctrine Command (TRADOC) Futures Battle Lab and Agile Commander Advanced Technology Demonstration (ATD). In FY03, provide technologies to facilitate concurrent Command and Control (C2) decision-making in a multi-echelon operation. In FY04, provide execution-centric technologies to assist Commanders in the Military Decision Making Process (MDMP). In FY05, provide technologies that ensure completeness and timeliness of decision-making in C2 operations.</p>	1070	1297	2092	2078
<p>- Design secure, stealthy, energy -efficient network protocols on a miniature radio to support the Networked Sensors, a key element of the internetted 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 FY02, identified low energy network technologies for a miniature radio that can be integrated in a miniature sensor to create a secure network in support of forward-deployed unattended munitions, sensors, and small robotic platforms; and determined technical requirements for a common network architecture for unattended sensor arrays and candidate protocols for very short duty cycle networks that use low power radios to control and transmit data from sensors, smart munitions and robots. In FY03, conduct experiments and test the protocols for miniature radios. In FY04, improve the range and energy efficacy of the network protocols for miniature radios. In FY05, conduct tests on sensor networks equipped with miniature radios.</p>	877	584	457	451

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602783A - COMPUTER AND SOFTWARE
TECHNOLOGY

PROJECT
Y10

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- 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 Objective Force (which consists of a heterogeneous mixture of individual soldiers, ground vehicles, airborne platforms, unmanned Aerial Vehicles (UAVs), robotics and unattended microsensor networks) will operate in a complex wireless environment where survivability must be maintained in spite of inherent vulnerabilities of standardized protocols and commercial technologies. In FY02, tested a laboratory version of mobile code for protecting tactical wireless networks, allowing Commanders to operate in a dynamically configurable environment. Identified and performed preliminary analysis of encryption algorithms and protection techniques for microsensors to reduce the vulnerability of unattended sensors arrays on the tactical battlefield. In FY03, devise encryption algorithms and deployment techniques. In FY04, conduct experiments with miniature sensors to validate robustness of algorithms. In FY05, provide suites of information protection codes to miniature sensor developers and deployers.	973	1060	682	673
- 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 wargaming, 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. In FY02, identified techniques to merge real time battlespace data for the simulation of selected courses of action and to determine their advantages and disadvantages. The simulations were tested using both force-on-force simulations and statistical models. In FY03, Improve combat models by applying statistical techniques into wargaming. In FY04, improve techniques to generate alternate COAs automatically for analysis. In FY05, provide the TRADOC Battle Labs with tools to conduct simulations in the field.	975	1060	911	900
Totals	3895	4001	4142	4102

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602783A - COMPUTER AND SOFTWARE TECHNOLOGY

PROJECT
Y10

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	4113	4354	4406	4465
Current Budget (FY 2004/2005 PB)	3895	4001	4142	4102
Total Adjustments	-218	-353	-264	-363
Congressional program reductions				
Congressional rescissions		-264		
Congressional increases				
Reprogrammings	-139	-23		
SBIR/STTR Transfer	-79	-66		
Adjustments to Budget Years			-264	-363

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	56911	55304	45407	46034	48645	50167	50618	51973
855 TOP,IMAGE INTEL&SPACE	9221	9870	10518	10747	11796	12110	12294	12594
EM2 FT GEORGE MEADE FUEL CELL DEMONSTRATION	2397	0	0	0	0	0	0	0
H71 ATMOSPHERIC INVESTIG	7129	6290	6085	6440	6662	6779	6741	6987
T40 MOB/WPNS EFF TECH	14914	16620	16869	16701	17669	18506	18672	19152
T41 MIL FACILITIES ENG TEC	4255	4576	4780	4689	4746	4862	4897	5026
T42 COLD REGIONS ENGR TECH	4733	3993	4083	4249	4382	4457	4510	4625
T45 ENERGY TEC APL MIL FAC	2691	2899	3072	3208	3390	3453	3504	3589
T48 CENTER FOR GEOSCIENCES & ATMOSPHERIC RESEARCH	0	1142	0	0	0	0	0	0
T49 UNIVERSITY PARTNERING FOR OPERATIONAL SUPPORT	3279	3241	0	0	0	0	0	0
T52 DOD FUEL CELL TEST AND EVALUATION CENTER	8292	6673	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this program element is to provide technologies in direct support of critical warfighter functions of mobility, countermobility, survivability, sustainment engineering, and topography needed to transform the force. Research is conducted that supports special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Research is transitioned to PE 0603734A (Military Engineering Advanced Technology) and to Project Managers (PM) such as PM Combat Terrain Information Systems, PM Force Projection, and PM Close Combat Systems. 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 support 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; Energy Technologies, including renewable and distributed energy supplies such as stationary fuel cells; Facilities Engineering, including facility acquisition and revitalization, installation operations, and modeling and simulation for installation transformation; C4 technology, including terrain awareness, C2 software, communications software and components; and ISR technology, including signal processing, automatic target recognition, and RF sensors/devices.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING TECHNOLOGY

This research will improve the efficiency and cost effectiveness as it relates to supporting the training/readiness/force projection missions in garrison and force sustainment missions in theaters of operation. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center and the U.S. Army Research Laboratory. This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the program.

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	59354	51124	53676	56325
Current Budget (FY 2004/2005 PB)	56911	55304	45407	46034
Total Adjustments	-2443	4180	-8269	-10291
Congressional program reductions				
Congressional rescissions		-6628		
Congressional increases		11600		
Reprogrammings	-1887	-318		
SBIR/STTR Transfer	-556	-474		
Adjustments to Budget Years			-8269	-10291

Change Summary Explanation: Funding - FY 2004/2005: Funds realigned to higher priority requirements in the areas of space imaging and target exploitation, battle weather intelligence, and design, construction and revitalization of facilities.

FY03 Congressional Adds:

DoD Stationary Fuel Cell Buy Down Program, Project T52 (\$7000); Center for Geosciences, Project T48 (\$1200); University Partnership for Operational Support, Project T49 (\$3400).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)**February 2003****BUDGET ACTIVITY
2 - Applied Research****PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING TECHNOLOGY**

Projects with no R-2As:

- (\$7000) DoD Stationary Fuel Cell Buy Down Program, Project T52: The objective of this Congressional Add is to support the development and commercialization of domestic stationary fuel cell systems. No additional funding is required to complete this project.
- (\$1200) Center for Geosciences, Project T48: The objective this Congressional Add is 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.
- (\$3400) University Partnership for Operational Support, Project T49: The objective of this 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 (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A - MILITARY ENGINEERING TECHNOLOGY					PROJECT 855			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
855 TOP,IMAGE INTEL&SPACE	9221	9870	10518	10747	11796	12110	12294	12594	

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 to enable Objective 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/atmospheric data is provided for this project by the US Army Research Laboratory project H71 in this program element. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
855

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Data Generation – In FY02, developed software to rapidly extract and properly characterize geospatial information of importance to Army and DoD customers. Incorporated knowledge-based techniques to automate and improve digital stereo photogrammetric workstation operations for feature extraction and attribution. Developed new terrain and target detection/classification algorithms that reduced terrain misclassification by a factor of 2. In FY03, develop automated data generation algorithms for tactical level features and attributes that are needed in tactical Assured Mobility decision aids. Develop algorithms that combine terrain information and target identification from different sensors. In FY04, integrate algorithms and demonstrate ability to identify targets and classify terrain. Develop automated methods to detect minor geomorphic changes that affect FCS mobility. In FY05, develop and release software for automated methods to assess soil moisture and drainage attributes for Assured Mobility requirements. Transition these developments to PM Combat Terrain Information System to support tactical analysis and decision-making.	3287	3850	3811	3955
Data Management – In FY02, assessed, formulated, and performed research of technologies to support geospatial data integration that would allow the soldier to have a single picture of the battlespace regardless of the number of data sources. In FY03, develop automated cross sensor registration tools to correct for image inaccuracies so that users will be looking at the same object, regardless of sensor type. In FY04, develop automated multi-feature registration to provide warfighters with a single view of data. Provide data management software that will be able to incorporate new data sources to improve analysis of time-sensitive geospatial information. In FY05, formulate geospatial data integration techniques to permit more intuitive presentation and more rapid comprehension of complex terrain data sets to support military planning and battle command and control.	1272	1777	1961	2306

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
855

Accomplishments/Planned Program (continued)

Data Representation – In FY02, provided an internet based mapping capability and integrated current state of the art technology to provide the ability for rapid, as-needed, in-field, and seamless use of map and geospatial information world-wide. Developed a tactical capability merging weather and terrain data with thermal and signature models to produce a suite of multispectral 3D visualization products supporting intelligence preparation of the battlefield, mission rehearsal, and target area preview. Demonstrated software to help produce the synthetic terrain scenes utilizing high resolution overhead imagery for added scene detail. Created a prototype common environment database repository that can be used to support general planning, course of action analysis, mission rehearsal, and battle simulation. In FY03, develop methodologies to incorporate non-spatial intelligence data (e.g., vertical obstruction filer and descriptive information to provide and enhance feature attribution) into geospatial databases. In FY04, create software to incorporate non-sensor derived data sources into current spectral sensor algorithms for geospatial data generation. In FY05, develop improved geospatial data access and distribution tools for more efficient dissemination of digital data for tactical systems.

FY 2002	FY 2003	FY 2004	FY 2005
2983	1875	2167	1636

Data Analysis – Battlespace Terrain Reasoning and Awareness will develop a comprehensive suite of battlespace environment terrain and weather effects Tactical Decision Aids (TDAs) that generate information and knowledge necessary to enable decision and execution processes across C4ISR systems and robotic platforms of the Objective Force. In FY02, created semi-automated methods to produce terrain modeling data sets for the Digital Topographic Support System (DTSS) and weather data sets for the Integrated Meteorological System for use with both infrared and millimeter wave scene visualization technologies. In FY03, develop geospatial tools and temporal terrain reasoning tools, which provide the capability to extract the fundamental elements of course-of-action analysis (COA). In FY04, integrate the ability to predict the dynamic state of battlespace environments to modulate the static components of COA. In FY05, create terrain-reasoning capability to provide time-sensitive course-of-action information for Objective Force applications.

1679	2368	2579	2850
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Totals

9221	9870	10518	10747
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A - MILITARY ENGINEERING TECHNOLOGY					PROJECT H71			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
H71 ATMOSPHERIC INVESTIG	7129	6290	6085	6440	6662	6779	6741	6987	

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 Objective 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), through support to the Program Manager for Night Vision/Reconnaissance Surveillance and Target Acquisition (PM-NV/RSTA) for field artillery systems, and to the Department of Defense (DoD) modeling community. It provides the weather data from forecast/nowcast models, the distributed four dimensional (4D) weather database, and the weather decision aids that use this data for the digital battlefield commander by applying advanced computer techniques; incorporating new technology in meteorological sensor and system designs; researching data fusion techniques to horizontally integrate data from advanced weather sensors and non-weather sensors into decision aids for enhanced combat power on the battlefield and enhanced effectiveness of field artillery and deep attack assets. This project supports the Army's transformation to the Objective Force through future applications and platforms that support echelons at Brigade and below, down to the individual soldier, and Defense Technology Objectives, Weather/Atmospheric Impacts on Sensor Systems, and On-Scene Weather Sensing and Prediction Capability. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
H71

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Mature a new high resolution, short-range forecasting capability based on integrating new battlefield meteorological data sources (non-conventional meteorological sensors such as Unmanned Aerial Vehicles, Unattended Ground Sensors, and robotic sensors) into model initialization which will directly impact nowcast/very short-range forecast accuracy especially over the target area, and provide much higher resolutions over the theater of operations. In FY02, verified the new Cumulus Parameterization Scheme for estimating convective precipitation to transition into the Integrated Meteorological System and field artillery meteorological models. In FY03, apply a test set of methods for integration of non-traditional meteorological data sources to Army meteorological forecast models. Begin evaluation of the modified models with emphasis on target areas and short-term forecasts. In FY04, evaluate and modify as needed model packages that include a microscale diagnostic model for very fine resolutions nested in a mesoscale predictive model. In FY05, evaluate models with a complete set of modifications for insertion of likely sources of meteorological data from the battlefield. Evaluate model package for very fine scale analysis that uses data from non-traditional sources likely to exist on the net-centric battlefield.	956	2076	1950	2072
Implement a research version of the Battlescale Forecast Model (BFM) that has software for ingesting data from meteorological satellites, Unmanned Aerial Vehicles, and distributed ground-based sensors. Research and test the capability to host the BFM on battlefield gun platforms to allow for fully autonomous artillery meteorological message generation during battle. In FY02, investigated weather effects software that provides accurate artillery-tailored weather effects decision aids for trajectory analysis, targeting, and go/no-go forecasts to the fire control databases. Modified the BFM to accept weather data from local and RSTA sensors for improved meteorological data collection and utilization. In FY03, evaluate artillery improvement algorithms using the research model. Complete a set of artillery-tailored decision aids for evaluation using model output and real data. In FY04, evaluate the set of artillery-tailored decision aids. Modify the research model as needed for operation on the processors expected to be available on gun platforms of the Future Combat Systems and in use as part of the NetFires concept. In FY05, evaluate the modified research model for operation on gun platform processors. Modify and evaluate the research model for its ability to accept and process data from local and RSTA sensors. Evaluate the gain in accuracy of the modified model.	1355	1195	1181	1261

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

**BUDGET ACTIVITY
2 - Applied Research**

**PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY**

**PROJECT
H71**

Accomplishments/Planned Program (continued)

Integrate distributed weather client applications and database connectivity with the Army Battle Command System or other Command, Control, Communications, Computing and Intelligence (C4I) systems identified for Future Combat Systems Command and Control "on the move" in order to utilize new weather effects decision aid technology at lower echelons through hand-held visualization devices such as Personal Digital Assistants (PDA's). Incorporate sets of weather algorithms that can be integrated into existing soldier and system embedded processors describing basic information for the individual soldier on current terrain and weather conditions, weather forecasts, weather warnings, heat stress, canteen use, and meteorological satellite imagery. In FY02, matured distributed weather client applications for push/pull of forecasts and weather impact decision aids to soldier-level interactive displays. Proved out the wireless capability to display limited forecast data and decision aids on PDA hand-held devices. In FY03, augment the capability of the PDA to accept and process data from "reachback" databases to increase capability and timeliness. Upgrade the number and application of the PDA software for weather effects decision aids. In FY04, mature an upgraded capability to access and process data from other battlefield processors that will have applicability to the Objective Force. Evaluate the PDA software in exercises that evaluate its effectiveness. In FY05, implement software on the PDA that can be used as part of a package of software for the wearable computer for the Future Warrior.

<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
876	629	674	787

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
H71

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Increase effectiveness of target acquisition in urban and other domains by applying advances in optical turbulence research for atmospheric effects on modern small aperture sensors and lasers, and new models for the effects of nighttime light scattering due to urban light pollution on night sensors into advanced tactical decision aids for use in RSTA planning, special operations, and Objective Force Warrior. Integrate hyperspectral and polarimetric imagery to extend target signature analysis, improve target acquisition capabilities and evaluate polarimetric imaging techniques, including improved imager performance against camouflage and decoys. Incorporate these polarimetric imaging techniques into sensor platforms being developed for the Future Combat Systems. In FY02, evaluated polarimetric imaging techniques for support of Army missile systems. Completed approximately 3,000 new rule thresholds for various weapons systems, both friendly and threat, that will be used in developing new generation of physics-based tactical decision aids. In FY03, mature weather effects for interface into Army Warfare System/Joint Warfare System (AWARS/JWARS) war games. In FY04, create a model for determining environmental effects for urban target acquisition and urban inherent signatures. In FY05, mature capability to use remote sensing imagery to identify urban signatures operationally and urban combat simulations used in mission planning.	935	1069	1036	1089
Measure single particle fluorescence spectra and scattering signatures of biological and natural aerosols in the atmospheric boundary layer. In FY02, assessed a prototype fluorescent particle sensor for bio-hazard detection and identification. Researched and created new data retrieval methods that can be used in conjunction with a broadband Light Detection and Ranging (LIDAR). In FY03, create algorithms to use these measurements to improve chemical/biological aerosol detection capability. In FY04, research laser based techniques for aerosol detection/classification using polarization scattering for aggregate particles. In FY05, improve other laser-based techniques for aerosols detection/classification including plasma emission for elemental composition, and broadband LIDAR for size distribution and concentrations.	1062	944	922	898
Integrate the effects of vegetation and terrain on acoustic propagation into a battlefield decision aid and extend the acoustic decision aids to infrasonic frequencies for intelligence operations. In FY02, the Acoustic Battlefield Aid (ABFA) decision aid was implemented in the Integrated Weather Effects Decision Aid (IWEDA) suite. In FY03, establish an infrasound test site, develop infrasonic signature database. In FY04, implement high compression techniques for acoustic and infrasonic data retrieval. In FY05, create a first principles, three dimensional (3D) propagation model capable of handling dynamic atmospheric inputs and complex ground surfaces to produce high-fidelity simulated signals and realistic environmental impact for acoustic sensors.	443	377	322	333

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
H71

	FY 2002	FY 2003	FY 2004	FY 2005
<p><u>Accomplishments/Planned Program (continued)</u></p> <p>Supported collaborative research in various aspects of environmental sciences to include data assimilation, chemical and biological aerosols, and numerical weather prediction capabilities. In FY02, the external partner, Colorado State University, Center for Geosciences/Atmospheric Research delivered to Army elements, a hydrological model that improved rainfall prediction, a cloud drift wind algorithm for development of an automated cloud feature system, a prototype numerical weather prediction model that initializes using data from non-conventional sources, and a water vapor retrieval algorithm based on using the Bayesian Method.</p>	1502	0	0	0
Totals	7129	6290	6085	6440

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A - MILITARY ENGINEERING TECHNOLOGY					PROJECT T40			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
T40 MOB/WPNS EFF TECH	14914	16620	16869	16701	17669	18506	18672	19152	

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; rapid establishment and repair of lines of communications (roads and bridges); expedient protection for the warfighter during contingency operations; and rapid port enhancement. This research supports development of the Future Combat Systems (FCS) and Objective Force by providing physics-based representation of mobility, obstacle and barrier creation, survivability, and weapons effects in urban terrain in modeling and simulation. Additionally, the project will mature technologies that will increase the survivability of critical assets from conventional and terrorist weapons, and sustainability of deployed forces, while reducing their logistical footprint. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T40

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Force Protection - In FY02, produced guidance for designing survivability measures to protect base camps from small arms, rockets, and fragmentation threats. Integrated survivability designs and measures into Anti-Terrorist Planner software. In FY03, will develop systematic procedures to identify construction methods and characterize their material properties. This development will characterize buildings world-wide based on 20 structural types. In FY04, develop guidance for rapid construction of survivability and fighting positions tailored to urban environments. This effort will increase probability of survival of personnel and critical assets in urban structures by a minimum of 30% from enhanced blast and fragmentation weapons. In FY05, will increase number of structural types that can be rapidly assessed from 13 to 20 structural types.	4188	1995	1968	1917
Weapons Effects and Structural Response – In FY02, incorporated damage prediction algorithms for remaining infrastructure components in vulnerability assessment software for protection of the selected critical infrastructure from asymmetric terrorist attacks. Provided validated techniques for lighter, more survivable protection by predicting ground shock and structure-media interaction. In FY03, produce methods for predicting blast effects on protected and unprotected structures and ground shock effects in different rock types, and improve techniques for predicting high velocity penetration into structural materials, such as concrete. In FY04, complete methodology to predict airblast coming from adjacent buildings. In FY05, complete methodology to predict very high velocity projectile penetration in soil, and quantify the effects of explosive types on structures and soil.	2474	2659	2776	2965
Materials and Criteria for Protective Construction – Provides material solutions, implementation guidance, and structural modeling capabilities for increased survivability against current and future weapon and sensor threats. In FY02, matured analytical design/analysis methodologies for forced entry threat mitigation and produced Simplified Survivability Assessment (SSA) software for troop use. In FY03, mature elastomeric polymer structural retrofit capabilities for protection of conventional construction. In FY04, evaluate protective concepts for theater missile defense systems used in transforming the force. In FY05, produce enhanced SSA including analysis of emerging threat weapon systems.	1439	1995	2351	2360

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T40

Accomplishments/Planned Program (continued)

Airfields, Pavements & Sustainment Engineering/Joint Rapid Airfield Construction - In FY02, assessed materials and methods for rapid airfield construction. In FY03, integrate advanced construction technologies to enhance airfield construction productivity. In FY04, demonstrate improved construction techniques and C-130 capable technology. In FY05, develop advanced stabilization techniques to reduce cure time from 30 days to 1-2 days while reducing logistical footprint. Rapid Port Enhancement - In FY03, modify the Coastal Integrated Throughput Model to include attributes and capabilities of the Theater Support Vessel and rapid port enhancement products. Determine rapid force projection and sustainment Sea Port of Debarkation enhancement requirements for future sealift operational scenarios; produce initial suite of overall port enhancement design concepts including application of "hydro-beam" technologies and integration of coastal climatological database system; produce Coastal Integrated Throughput Model Version III, including stochastic modeling capability. In FY04, perform coastal throughput assessment for rapid force projection and sustainment operations for a particular theater of operation to include assessment of capabilities to meet force projection demands associated with the Army Transformation; test database methodology for final Theater Support Vessel design capabilities and provide parameter affecting throughput to the Coastal Integrated Throughput Model. In FY05, integrate Coastal Integrated Throughput Model into larger-scaled modeling systems and applications; conduct intermediate-scale experiments for "hydro-beam" causeway and near-shore breakwater.

FY 2002	FY 2003	FY 2004	FY 2005
1439	3656	3574	3337

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T40

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>Mobility Modeling – Provides procedures to accurately quantify maneuver and select best network routes over and around obstacles, in urban and non-urban areas, during all weather conditions, to synchronize speed, agility, and flexibility of disbursed tactical units. In FY02, evaluated hydrology model for effect/assessment on maneuver/counter maneuver during rapid force projection in worldwide scenarios. Developed improved pavement materials and expanded pavement design and analysis model for rapid, accurate and reliable prediction and enhancement of airfield performance using current and future aircraft criteria. In FY03, mature solutions for rapidly assessing condition and predicting future performance of roads and bridges in theater of operations to expedite route planning. In FY04, mature solutions for predicting future performance of roads and bridges to expedite throughput assessment. In FY05, provide materials and methods for rapidly upgrading or expanding existing lines of communication for increased throughput capacity with a reduced logistics footprint. Mature advanced throughput models for intelligent maneuver decisions including bypass options, route planning, resourcing, and management tools. Determine mobility performance requirements for advanced vehicle platforms such as FCS. Quantify maneuverability within urban environments on the future battlefield. Create hydrologic decision analysis capability for rapid in-theater maneuver assessment for the warfighter.</p>	3328	4155	4806	4769
<p>Decision Support – In FY02, integrated spatial, predictive and weather software into Digital Topographic Support System architecture for verification and validation. Provided a capability to analyze the obstacle effects of craters on ground vehicles in the One Semi-Automated Force (OneSAF) simulation and a capability for dam breach analysis in TeleEngineering Toolkit. In FY03, develop realistic mobility portrayals as a function of short-term changes in the ground-state to support unit movement evaluation. Provide digital reconnaissance applications to allow rapid remote main supply route assessments via TeleEngineering. In FY04, develop improved NoGo/obstacle analysis. Incorporate the Watershed Modeling System into the OneSAF simulation to provide watershed and riverine analysis. In FY05, develop additional improvements to NOGO/obstacle analysis. Provide algorithms for rapid building generation, advanced vehicle platforms performance, a baseline representation of vehicle maneuverability and improve the representation of smart munitions effects in modeling and simulation.</p>	2046	2160	1394	1353
Totals	14914	16620	16869	16701

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A - MILITARY ENGINEERING TECHNOLOGY					PROJECT T41			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
T41 MIL FACILITIES ENG TEC	4255	4576	4780	4689	4746	4862	4897	5026	

A. Mission Description and Budget Item Justification: The objective of this project is to perform applied research necessary to delivery sustainable, cost efficient and effective facilities; and provide installation operations required to support the Objective Force. The project focuses on facilities and operations advanced 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 quality of facilities and enhance soldier quality of life, thereby enhancing soldier retention. Technologies evolving from this work include composite rehabilitation materials, multi-hazard mitigation, electromagnetic shielding, concurrent engineering processes, sustainable facility management, collaborative decision support, and knowledge processing. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T41

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Facility Modeling and Simulation – The Fort Future program will develop the capability to model, simulate, assess, and optimize installation capability to support the Objective Force (OF). The technology will enable a more holistic approach to facility design, including incorporation of anti-terrorism and sustainability (e.g., energy, water, environmental) considerations that currently threaten long-term viability of installations. In FY02, developed capability to deliver facilities that better match OF requirements in a shorter time by automating requirements generation, speeding up generation of designs, and increasing reuse of designs that have already been generated. Completed beta version of the GeoBest sustainment model that predicts facility requirements for initial/bare base construction standards. In FY03, simulate force projection flow through the installation in order to provide a local optimization tool and to enable a risk-based approach to investing in mission-critical infrastructure. In FY04, develop integrated tools for judging suitability of infrastructure to support power projection, readiness, threat vulnerability, and sustainability requirements. In FY05, validate prediction and optimization algorithms for installation capability to support Army Installation Transformation.</p>	1943	2562	2178	1949

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T41

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Facility Engineering – In FY02, completed seismic vulnerability evaluation guidance for building floor and roof elements in Army facilities for assessing compliance with current seismic criteria. Developed and tested "self-healing" coatings which exhibited a 30% reduction in undercutting (improved corrosion protection) compared to conventional coatings. Completed a prototype model for reliability-based maintenance of Army infrastructure for maintenance planning and cost reduction. In FY03, generate analytical models and design guidance for seismic rehabilitation of reinforced concrete frames with masonry infill to comply with current seismic criteria. Develop an Installation Mission Essential Task List requirements process to directly tie resource decisions to unit mission. In FY04, develop performance envelope for composite structural repair and upgrade materials for predicting long-term usage in maintaining and improving infrastructure. Develop innovative strategies and business practices for Army roofing asset management to reduce cost of roof replacement. Develop prototype sector analysis and modeling for strategic sourcing. In FY05, complete fiber reinforced polymer rehabilitation concepts and methodologies for seismic strengthening. Develop short-term impedance testing parameters as indicators to predict performance for corrosion resistant coating systems. Develop a holistic integrated tool, system and service to optimize regional and local installation management across power projection, training, and industrial tenant units in support of Army Installation Transformation.	2312	2014	2602	2740
Totals	4255	4576	4780	4689

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
**0602784A - MILITARY ENGINEERING
 TECHNOLOGY**

PROJECT
T42

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
T42 COLD REGIONS ENGR TECH	4733	3993	4083	4249	4382	4457	4510	4625

A. Mission Description and Budget Item Justification: This project provides advanced technologies for developing planning and assessment tools, innovative construction materials for extreme climatic conditions and techniques, and procedures to improve Objective Force capabilities throughout cold regions of the world. Further, this project focuses on minimizing or eliminating the dramatic effects of dynamically changing terrain states on sensing and maneuver operations 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 the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. The work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T42

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Terrain State – In FY02, proved feasibility of using dynamic terrain state models in a tactical setting, with tactical computing assets to support sensor performance and mobility predictions in support of Battlespace Terrain Reasoning and Awareness. Completed mechanistic model for pavement design and evaluation to prevent and alleviate frost heave and thaw weakening, thermal cracking, cracking induced by structural loading during thaw periods. In FY03, develop realistic winter mobility portrayal as a function of short-term changes in the ground state to support unit movement evaluation. Complete site assessment methodology and establish criteria for remedy of high moisture content soils. Will develop all-season material models that will simulate the mechanical behavior of different terrain materials (freezing/thawing soil), ice, and snow to improve simulation of vehicle-terrain interaction in support of TARDEC led High Fidelity Ground Platform and Terrain Mechanics Modeling program. In FY04, develop terrain state modeling and sensor performance tactical decision aids (TDAs). Complete ground and support assessments for strengthening indigenous soils during thaw periods for rapid all-season construction of forward theater airfields. Extend finite element modeling of tire-terrain interactions to these materials. In FY05, develop models and tactical decision aids for commander's mobility analysis and course-of-action decisions. Establish remote site assessment, evaluation and selection techniques for Joint Rapid Airfield Construction. Develop high fidelity real-time motion environment to study moving vehicle operations and mitigating factors.</p>	2957	3155	3207	3387
<p>Signature Physics – In FY02, developed a geophysical model of Yuma Proving Grounds Smart Weapons Test Range for use in simulation-based system prototype development and advanced target location and tracking capabilities for unattended ground sensor seismic sensing arrays. Performed seismic simulation sensitivity study of ground vibrations coming from armored vehicles moving over varied terrain, to verify accuracy of seismic simulations in comparison to field test results of moving tracked vehicles in support of ARDEC led Advanced Acoustic Seismic Systems program. In FY03, finalize high fidelity seismic propagation modeling. Modify thermal models to include a wider range of manmade materials in support of ARL's Command and Control (C2) in Complex and Urban Terrain program. In FY04, develop tactical terrain thermal modeling tools for urban and complex features. Establish basis for developing generic performance criteria for sensor TDAs. In FY05, adapt for local geology, algorithms for unattended ground sensors in seismic sensor networks. Develop query and subscription based incorporation of signature physics tool set with C2 collaboration tools.</p>	784	838	876	862
<p>Winter Base Camp Construction - This one year Congressional Add demonstrated improved base camp winter construction techniques and procedures. No additional funding is required to complete this project.</p>	992	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T42

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Totals	4733	3993	4083	4249

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A - MILITARY ENGINEERING TECHNOLOGY					PROJECT T45			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
T45 ENERGY TEC APL MIL FAC	2691	2899	3072	3208	3390	3453	3504	3589	

A. Mission Description and Budget Item Justification: The objective of this project is to provide technology necessary to provide cost effective, energy efficient, sustainable military installations, emphasizing a secure and reliable energy supply for Army Installations supporting transformation. Advanced energy technologies and processes are also applied to the Army's industrial base to maintain its cost-effective readiness for munitions production. Advanced technologies include integrated, distributed and renewable energy supply, hybrid cooling, and microturbines for Army application at all installations, to include theater of operations. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING
TECHNOLOGY

PROJECT
T45

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Installation Modeling and Simulation – The Fort Future program will develop the capability to model, simulate, assess, and optimize installation capability to support the Objective Force. In FY02, identified threats and options for chem/bio mitigation in water systems. Studied threats and options for chem/bio hardening of facility air handling systems for incorporation into the Fort Future modeling and simulation system. In FY03, adapt utility distribution system software models to military scenarios including mobilization (Force Projection) and response to terrorist threats such as chem/bio contamination (Force Protection). In FY04, develop dynamic risk models to analyze supply and demand energy/environment distribution systems to include chem/bio 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.</p>	1293	1884	2012	2097
<p>Secure/Reliable Utility Systems – In FY02, updated Army energy strategy to reflect the latest supply and demand energy technologies and terrorism threats. Conceptualized standard control system protocol for Army facilities to ensure common operating maintenance practices on all Army installations. In FY03, craft energy control system architecture and protocol compatible with facility technologies to optimize building energy performance and worker comfort and productivity. In FY04, adapt supply and demand technologies to communicate through control network allowing for multiple building control networks that are highly reliable. In FY05, adapt emerging supply and demand equipment (i.e. next generation fuel cells, air-conditioning) to communicate through control systems for critical military facilities.</p>	1398	1015	1060	1111
Totals	2691	2899	3072	3208

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602785A - Manpower/Personnel/Training Technology						PROJECT 790	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
790 PERSONNEL PERFORMANCE & TRAINING TECHNOLOGY	14367	13070	15548	15607	15897	16596	16847	17192

A. Mission Description and Budget Item Justification: The objective of this program is to provide the scientific and technical basis for personnel selection, leader development, and training that will ensure that the human component of warfighting can maximize the benefit of transformations in advanced technologies, weapons, and equipment (e.g., Future Combat Systems) and can perform effectively in Objective Force operations. This applied research program will provide methods, techniques, and tools to improve the assignment procedures to ensure the right person is placed in the right job, develop improved methods for developing leader cognitive skills, and provide the behavioral science technologies required for the development of effective individual and collective (unit) training strategies. Research topics include training strategies for the digitized battlefield; strategies to maximize the training effects in simulated environments; optimum designs and utilization of simulators and training devices to achieve maximum learning at minimum cost; and modernization of the selection and classification systems to maintain warfighting capabilities for future forces. Beginning in FY 2004, a major thrust of this program will be to expand Leader Development applied research beyond the existing work on more effective methods to develop the critical thinking skills that leaders must have to make effective battlefield decisions in rapidly changing operational situations and in information-rich environments. Additional research will be initiated on developing the interpersonal skills needed by small unit leaders to rapidly form cohesive teams with continuously changing mission requirements and personnel turbulence, and to effectively operate with diverse groups (joint, multi-cultural, interagency, etc.); and on developing mentoring and coaching skills so leaders can support early development of leadership skills and adaptability in younger leaders. Research in this PE is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance and supports the Human Systems - Personnel, Training, and Leader Development - Defense Technology Area. It supports the Objective Force transition path of the Transformation Campaign Plan. This PE is managed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and contains no duplication with any effort within the Military Departments.

This program does not contain Defense Emergency Response Funds.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602785A - Manpower/Personnel/Training
Technology

PROJECT
790

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Personnel Selection and Assignment: In FY02, identified future-oriented job requirements for entry-level soldiers to ensure future selection systems will meet Objective Force operational requirements; determined the best predictor tools for building the NCO promotion system of the future; and identified potential ways to reduce the number of soldiers who leave the Army before completing their first term of enlistment. In FY03, identify knowledge, skills, and attributes needed for soldiers to successfully perform in future jobs (e.g., for the Objective Force); validate new screening tools for Army recruiters and quantify the amount of improvement offered by these tools over the current recruiter selection system; assess recent technological advances in job/skill performance certification and propose the design of Army enlisted job certification measures. In FY04, identify and develop predictors and measures of future enlisted soldier job performance; validate new screening tools for station commanders and develop implementation strategies for new recruiter and station commander screening batteries; and develop prototype job certification measures. In FY05, recommend procedures for a more flexible enlisted selection and classification system that can keep pace with changing job requirements; begin a formal validation of a new system for trainers and commanders to certify that soldiers qualify on the skills necessary for effective job performance.</p>	3659	3863	4075	3875

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602785A - Manpower/Personnel/Training
Technology

PROJECT
790

<u>Accomplishments/Planned Program (continued)</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Training: In FY02, determined the behaviors that need to be performed by computer-simulated forces to train effectively for urban operations and the best methods to accomplish the training; identified key C4ISR skill requirements and preliminary measures of proficiency for commanders and staffs operating advanced technology systems; improved rotary-wing flight training intelligent tutoring systems with enhanced visual system; and evaluated techniques to train and assess situational awareness so small unit leaders can take full advantage of battlefield information. In FY03, incorporate advanced simulation methods into new qualification instruction for OH-58D helicopters and test for improved performance, safety, and reduced costs; identify requirements for automated tools to measure C4ISR skills; identify methods to train small units to identify critical battlefield information to fully utilize capabilities of evolving soldier systems (e.g., OFW); and develop preliminary metrics for assessing small unit soldier and leader performance that are flexible enough to transition as new systems are fielded. In FY04, identify the roles of simulators and live aircraft within a model of simulation-intensive collective aircrew training; formulate principles for training key C4ISR skills; and develop methods to improve small team battlefield visualization to increase situational awareness and avoid situational confusion. In FY05, evaluate prototype simulation-intensive collective aircrew training programs; develop methods for training key C4ISR skills for FCS Unit of Action commanders and staffs; and formulate principles of effective performance measurement in future environments. It will also tailor successful embedded training approaches to assess small unit leader and team decisionmaking and information utilization skills; determine the critical elements to be taught and measured in multi-player simulations to improve performance in asymmetrical scenarios.</p>	7080	7322	7410	7721
<p>Leader Development: In FY02, improved how thinking skills are developed for mid-level leadership assignments and developed a prototype "Think-Like-A-Commander" to train remote-linked decision groups. In FY03, assess the utility of developing leader interpersonal and teamwork skills using a mix of film, animation, and role playing innovations. In FY04, pilot test an experimental interactive program to develop socially competent and conceptually adaptable leaders and develop tools for assessing adaptability in real-world operations. In FY05, test interactive tools to enhance team effectiveness through more accurate communication and understanding of commander (battalion and brigade) and team member intent and refine measures of effective leader skills.</p>	3628	1885	4063	4011
Totals	14367	13070	15548	15607

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	31650	34239	29421	21375	22652	25638	22167	20070
283 AIRDROP ADV TECH	6192	5672	2454	2522	2248	2290	2317	2375
C60 AC60	1357	0	4065	4522	1764	3821	0	0
E01 REACTIVE NANOPARTICLE MATERIALS	0	2335	0	0	0	0	0	0
E02 CHEMICAL BIOLOGICAL COMMAND	0	953	0	0	0	0	0	0
H98 CLOTHING & EQUIPM TECH	15796	15343	17928	9191	13582	14337	14584	12298
H99 JOINT SERVICE COMBAT FEEDING TECHNOLOGY	7347	7077	4974	5140	5058	5190	5266	5397
WA1 CENTER FOR RELIABLE WIRELESS COMM TECH	958	2859	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This Program Element (PE) improves soldier survivability and performance by researching and investigating technologies for: combat clothing and personal equipment; combat rations and combat feeding equipment; and the air delivery of personnel and cargo. 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; enhance signature management and integration; provide wearable, conducting materials to augment data and power transmission; 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 develop 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 and development of high impact/high payoff technologies for performance enhancing combat rations, 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. Similarly, 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 cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. It adheres 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) Food & Nutrition Research & Engineering Board. The program element contains no duplication with any effort within the Military Departments.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

Efforts are related to and fully coordinated with those in PE 0603001A (Warfighter Advanced Technology). Work is performed by the Natick Soldier Center, Natick, MA. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	33474	25502	23655	23141
Current Budget (FY 2004/2005 PB)	31650	34239	29421	21375
Total Adjustments	-1824	8737	5766	-1766
Congressional program reductions				
Congressional rescissions		-1976		
Congressional increases		11550		
Reprogrammings	-1251	-196		
SBIR/STTR Transfer	-573	-641		
Adjustments to Budget Years			5766	-1766

Change Summary Explanation: Funding - FY03 Congressional Adds: Soldier Systems Center, Project H99 (\$2100); Center for Reliable Wireless Communications Technology for Digital Battlefield, Project WA1 (\$3000); Standoff Precision Aerial Delivery System aerial drops, Project 283 (\$3000); Chemical/Biological Command, Natick Soldier Center, Project E02 (\$1000); Chemical/Biological Reactive Nanoparticle Materials, Project E01 (\$2450)

Projects with No R-2A:

- (\$2859), Project WA1, Center for Reliable Wireless Communications Technology for Digital Battlefield: The objective of this one year Congressional add is to support research in a wireless test bed facility for potential application to digital communications. No additional funding is required to complete this project.
- (\$2335), Project E01, Chemical/Biological Reactive Nanoparticle Materials: The objective of this one year Congressional add is to support research on nano-based process to improve chem/bio protection in textiles. No additional funding is required to complete this project.
- (\$953), Project E02, Chemical, Biological Command: The objective of this one year Congressional add is to support research to improve airbeam shelter materials. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
283

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
283 AIRDROP ADV TECH	6192	5672	2454	2522	2248	2290	2317	2375

A. Mission Description and Budget Item Justification: This project researches technologies to enhance cargo airdrop and personnel capabilities. These are key to Army Transformation rapid deployment and insertion capabilities for force projection, particularly into hostile areas. Areas of emphasis include parachute technology for improved performance, precision offset aerial delivery, soft landing technologies, airdrop simulation, and low altitude/high speed airdrop systems technologies. Efforts will result in increased personnel safety, more survivable and more accurate cargo delivery and reduced personnel, aircraft, and cargo vulnerability. The goal for personnel parachute technology is to increase personnel safety by providing an auto sensing capability to trigger parachute opening in the event the parachutist is incapacitated or disoriented and therefore unable to respond to a malfunction. This project will enhance the military's capability for global precision delivery and rapid force projection and supports the rapid deployment goal of the Army Transformation. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
283

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Advanced Air Cargo Delivery - In FY02, researched components and technologies in support of the Deployment Combat Aerial Delivery program and transitioned to 6.3 programs; utilized Airdrop System Modeling to simulate brassboards and prototypes in tech base and development programs (such as the Affordable Guided Airdrop System and the Advanced Tactical Parachute System) while validating the results with flight test data; and researched concepts for, and feasibility of, developing a 20-ton, high altitude (25,000 ft), high offset (up to 20 miles) precision airdrop system to provide greater deployability and sustainability for the Objective Force. In FY03, optimize the design of advanced low cost autonomous controllable airdrop systems utilizing high performance computing (HPC) modeling tools; design and conduct scaled tests on smaller and less expensive autonomous guidance navigation & control systems for low and primarily high altitude airdrop applications; complete the graphical user interface front end for Airdrop System Modeling tools. In FY04, complete the airdrop system modeling tool development and refinement. Conduct component modeling for Objective Force Precision Airdrop (30,000 lbs). In FY05, complete airdrop system model validation and transition high fidelity computer modeling tool to PM-Force Sustainment and industry. Conduct component-level evaluations for Objective Force Precision Airdrop.	3832	2083	1954	2522
Personnel Parachute Technology - In FY02, designed automatic opening capability system prototypes. In FY03, fabricate system component prototypes for automatic opening capability and conduct component-level field experiments. In FY04, conduct systems integration/human factor analysis for the parachute reserve automatic opening capability; and transition to 6.3 follow-on program.	596	789	500	0
Standoff Precision Aerial Delivery System (PADS) (Congressional add): In FY02, researched a computer based airdrop mission planner to improve the accuracy of ballistic and autonomous airdrop systems. In FY03, advance the near real time wind capabilities on Standoff PADS, mature computer-based airdrop mission planner and test the linkage of the PADS system via a wireless communication method to "smart" precision airdrop systems. No additional funding is required to complete this effort.	1764	2800	0	0
Totals	6192	5672	2454	2522

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602786A - LOGISTICS TECHNOLOGY						PROJECT H98	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H98 CLOTHING & EQUIPM TECH	15796	15343	17928	9191	13582	14337	14584	12298

A. Mission Description and Budget Item Justification: This project supports the Army Transformation in the area of improved dismounted soldier capabilities by researching and investigating technologies to improve soldier survivability and performance. Research emphasizes: 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 human science, modeling and analysis tools for optimizing soldier system clothing and equipment. The goal of the ballistic protection work is to research and mature advances in materials technology to improve the protection and performance of warrior armor systems against conventional and emerging ballistic threats. The lightweight soldier effort will reduce the weight of dismounted warrior systems by exploiting nanotechnology and by employing virtual prototyping tools to integrate warrior "system-of-systems" concepts on the human. The goal of the project's modeling effort is to develop essential analytic tools to quantify the military worth of next generation warrior systems (e.g., Objective Force Warrior) and evaluate the alternatives. This effort will produce modeling tools having the potential to reduce program risk by 50% in the areas of prototype development and system down-selection. The load carriage optimization effort is developing biomechanical methods, design guidance, and predictive analytical/statistical models addressing the human locomotion and load-bearing functions of the soldier system. These tools will enhance the efficiency of ground maneuver and the fightability of dismounted troops. Nanotechnology is being applied to several disparate soldier clothing and equipment areas, and potentially could revolutionize the performance of various soldier-worn components. The major nanotechnology effort focuses on researching 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 other nanotechnology effort is to produce conducting textiles that will eliminate multiple antennas currently required to accomplish the function of "whip" antennas (a signature problem). Conducting textiles also will enable conducting pathways to be included in textiles for data and power transmission, without compromising the flexibility and comfort of the clothing in which they are contained. The objective of the thermobaric blast protection activity is to characterize blast profiles and determine the hazard in order to provide improved protection concepts. This project leverages work performed by the Institute for Soldier Nanotechnologies supported by PE0601104A (University and Industry Research Centers) and PE0602105A (Materials Technology). This project accelerates technology development for transition to the Objective Force Warrior (OFW) Advanced Technology Demonstration (ATD). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
H98

Accomplishments/Planned Program

	FY 2002	FY 2003	FY 2004	FY 2005
Ballistic Protection for the Individual Warrior - In FY02, completed an improved personnel armor casualty assessment model that will permit evaluation of personnel armor systems against conventional and emerging ballistic threats. FY03, investigate an improved (over FY99 baseline) material system breadboard for 2nd generation multiple ballistic threat protection prototype with 25% decrease in weight (or an increase in protection or a combination, depending on user requirements). Develop an opaque armor system with 30% reduced areal density (over FY00 baseline) against fragment threat without incurring significant cost, bulk, or flexibility penalties. FY04, demonstrate technology with 30% reduced areal density over FY00 baseline against tungsten-carbide core projectiles (0.30 caliber or less). Demonstrate transparent armor technology for face protection with a 30% reduced areal density for fragmentation protection that will also provide handgun protection. Accelerate technology development for transition to the OFW ATD to meet FY05 design lock. FY05, conduct optimization of new fiber technology (e.g., M5) and material systems integration for advanced high performance materials (e.g., nanotechnology).	3452	2774	4882	2723
Lightweight Soldier Materials & Virtual Prototyping Tools - FY02, focused on the head and torso areas to advance the state-of-the-art in designing body-worn soldier clothing and equipment. Enhanced the capabilities of virtual prototyping tools. Completed beta simulations to test model effectiveness in biomechanical analysis. Produced breadboard prototype panels and system components made with nanomaterials for performance testing to determine the potential for significant system weight reduction and/or enhanced performance. FY03, collect/use human system data to enhance and verify virtual prototyping tools for soldier systems with human biomechanical and performance data. Evaluate the performance of breadboard prototype panels or system components made with nanomaterials to determine technology readiness for transition to the Objective Force Warrior program (PE63001, Proj J50), and to determine the path for further nanotechnology refinement and manipulation. FY04, complete verification of performance of nanotechnology-based system components and enhancements of virtual prototyping tools. Accelerate technology development for transition to the OFW ATD to meet FY05 design lock.	6831	6450	8803	0
Warrior Systems Modeling Technology - In FY02, developed close combat/small arms algorithms to assess warrior survivability and lethality at distances less than 25 meters. FY03, develop a capability to represent human behavior using reactive intelligent agents in the close combat/Military Operations in Urban Terrain environment. FY04, deliver a small unit, force-on-force, High Level Architecture compliant model to assess the combat effectiveness of warrior components and systems. FY05, develop next generation intelligent agent capabilities to expand the capability to assess information inputs and decision-making at the small unit level.	2236	2150	1830	2111

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
H98

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
Load Carriage Optimization for Enhanced Warfighter Performance - In FY02, developed design guidance for load carrying equipment that enhances mobility performance across squad positions by 15%. FY03, validate and finalize load carriage data and analysis for transition to the Warrior Systems Modeling Technology effort; evaluate physical training programs designed to improve locomotor performance.	1211	1300	0	0
Nanocomposites & Nanofibers for Warrior Systems - In FY02, improved the energy density and conversion efficiencies of photovoltaic nanostructures to functional levels for soldier system use through unique materials, modeling, processing/fabrication strategies. FY03, fabricate conformal solar cell devices with a minimum 30% reduction in weight (compared to current devices with similar power levels) for use in soldier systems. Test carbon nanotube arrays with broad band response for textile integrated antennas. FY04, mature technology for prototype conformal solar cells that can be directly integrated into warrior systems. Conduct research on a multifunctional nanomaterial-based textile undergarment system that includes flame resistance, anti-fungal, anti-microbial, chemical and biological warfare barrier and self-decontaminating capabilities. FY05, optimize integration of conformal solar cells into warrior systems; begin coupling of polymeric battery and solar cell devices for "all in one" power generation and storage (anytime power). Mature technology for organic elastomeric conducting textile fibers for conformal clothing applications.	1117	2168	1913	3357
Thermobaric Blast Protection - FY03, Model the propagation of thermobaric blast through protective clothing and model its interaction with the thorax. FY04, initiate experimental verification of predicted blast propagation through protective clothing and its interaction with the thorax and assessment of current thoracic simulators. FY05, conduct laboratory evaluation on proposed blast protective clothing concepts.	0	501	500	1000
This FY 2002 Congressional plus-up for Airbeam Manufacturing Process achieved advances in manufacturing technology to improve affordability and reliability of new inflatable, lightweight, textile based structures for rapidly deployable shelters to provide logistical support on a fast moving battlefield. No additional funding is required to complete this project.	949	0	0	0
Totals	15796	15343	17928	9191

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
H99

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
COST (In Thousands)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
H99 JOINT SERVICE COMBAT FEEDING TECHNOLOGY	7347	7077	4974	5140	5058	5190	5266	5397

A. Mission Description and Budget Item Justification: The Joint Services Combat Feeding Technology project researches and applies combat feeding and food system 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 develop technology that reduce field feeding logistics by over 75% (weight, cube, fuel and water) and labor requirements by 50%, while improving the quality of food service. Thrust areas include: combat rations, packaging, and combat feeding equipment/systems. Near-term goals include: enhancing nutrient composition and consumption to maximize cognitive and physical performance on the battlefield; reducing ration weight/volume and food packaging waste to minimize the logistics footprint; tailoring rations to the combat situation and radically improving mobility; reducing replenishment demand by extending shelf-life, permitting more extensive prepositioning of stocks, while maintaining initial quality; and providing equipment and energy technologies to reduce the logistics footprint of field feeding while improving the quality of food service. The work in this project supports all military Services, the Army's Objective Force, Special Operations Command, and the Defense Logistics Agency. The Army has Executive Agency responsibility for this DoD program, with oversight and coordination provided by the DoD Food & Nutrition Research & Engineering Board. This project has collaborative efforts with the U.S. Army Research Institute for Environmental Medicine (USARIEM). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
H99

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Equipment and Energy Technologies - FY02, designed/fabricated kitchen test bed for evaluating experimental cogenerators, refrigerators, sanitation, greywater recycling and field kitchen appliances. Tested cogenerators; researched thermoacoustic refrigeration and methods for safely tempering and storing perishable foods; tested experimental filtration and distillation prototypes; tested lightweight food sanitation center and transitioned to 6.3. Completed testing of Remote-Unit Self Heating Meals. FY03, integrate and test experimental cogenerators, refrigerators, sanitation, greywater recycling and experimental field kitchen appliances for Field-Feeding and Advanced Sustainment Technology (FAST); explore thermoelectric technology to provide hot water to re-hydrate meals and cold beverages for crew sustainment in Future Combat Systems. Develop methodology and models that estimate kitchen workload reduction for future kitchens. FY04, complete development of FAST and a crew sustainment system for Future Combat Systems; transition both to 6.3. Demonstrate Class I decision support tools and Field Feeding Kitchen Workload Models. FY05, design beverage chiller/water heater for the Objective Force Warrior; explore refrigerator container technology for the Battlefield Kitchen.</p>	1817	1992	2239	2369

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
H99

Accomplishments/Planned Program (continued)

Technologies for Ration Preservation & Stabilization, Revolutionary Packaging & Food Safety - FY02, investigated high-pressure ration processing for nutrient retention and sensory quality. Designed a family of shelf-stable breakfast concepts expanding menu choice, enhancing mobility, reducing weight by 53% and cube by 55%. Researched use of novel ration packaging technologies to extend quality/shelf-life of rations, reduce weight/signature, and minimize environmental impact. FY03, down select surface scanning technology for ration contamination assessment; transition to 6.3. Investigate pathogen technologies for developing ration components resistant to the virulent effects of food pathogens. Develop decision support tools to quantify/analyze annual cost impacts of current/alternative ration concepts, shelf life, rotation policies, and ration consumption mixes. FY04, increase sensitivity of probes to enhance antibody based pathogen sensor by 30-fold. Optimize novel processing/stabilization techniques. With USARIEM, prioritize next generation combat ration supplements that enhance warfighter cognitive/ physical performance. Incorporate research on pathogen resistant technologies into ration components and evaluate viability. Fabricate optimized ration packaging; transition to 6.3. FY05, complete development of probes, transition to biosensors and array diagnostics platforms. Verify shelf life of novel processing/stabilization techniques; transition to 6.3. Conduct validation studies for performance enhancing supplements. Develop self-hydrating membrane pouch using osmotic enhancing compounds for the safe/effective re-hydration of dried beverages/rations by non-potable water sources. Develop rapid, reliable, easy-to-use objective techniques for detecting ration degradation to reduce waste.

FY 2002	FY 2003	FY 2004	FY 2005
1968	2084	1710	1894

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

PROJECT
H99

Accomplishments/Planned Program (continued)

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Technologies for Nutrients and Novel Delivery Systems - FY02, initiated cellular assays to determine effectiveness of candidate nutraceutical compounds for transdermal nutrient delivery to delay fatigue or otherwise enhance human performance; designed and assessed methodologies for indexing the satiety value of military rations to improve acceptance and reduce battlefield waste; completed data analysis from Combat Optimized Rations Concept initial user evaluation, implemented changes and transitioned to First Strike Ration to reduce weight and cube; investigated technology for "smart" food ration components to sustain cognitive and physical performance. FY03, develop ration systems and novel components to enhance operational effectiveness (i.e.mobility), reduce weight/volume and optimize acceptance, consumption and performance; and down select anti-fatigue nutraceuticals. FY04, investigate and integrate glucose modulation, extrusion, encapsulation, oral mucosal absorption, drying, and hurdle technologies to provide novel nutrient delivery for ration components and enhance performance. FY05, complete development of ration systems and transition items such as gels, calorie- dense savory meat and vegetable bars, rehydratable bars, performance enhancing beverages and micronutrients to 6.3.	996	967	1025	877
Combat Feeding Research (FY02); Soldier Systems Center (FY03)- In FY02, this Congressional add completed three-year High Pressure Processing (HPP) Dual Use S&T Flow International press installation at FDA National Center for Food Safety Technology and initiated food product testing and microbial testing to gain FDA regulatory approval for HPP. In FY03, this Congressional add will develop processing parameters, optimize equipment/ration formulations and seek regulatory approval for novel processing techniques (radio frequency sterilization, microwave sterilization and high pressure processing) and identify/conduct efficacy testing of nutraceuticals for transdermal delivery systems. No additional funding is required to complete this project.	1588	2034	0	0
This Congressional add for the Army Nutrition Program supported USARIEM Military Nutrient Division through cooperative agreement with Pennington Biomedical Center in Louisiana. No additional funds are required to complete this work.	978	0	0	0
Totals	7347	7077	4974	5140

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	122121	124314	58877	61072	70351	68156	66969	65273
841 COMPUTER-ASST MINIMALLY INVASIVE SURGERY	10753	2003	0	0	0	0	0	0
845 BONE DISEASE RESEARCH PROGRAM	2685	1001	0	0	0	0	0	0
863 BTLFLD SURGICAL REPLAC	4509	4813	0	0	0	0	0	0
865 CENTER FOR MILITARY BIOMATERIALS RESEARCH	0	953	0	0	0	0	0	0
866 CLINICAL TRIAL PLEZOELECTRIC DRY POWDER INHALATION	0	1620	0	0	0	0	0	0
867 DIAGNOSTICS IN TRAUMATIC BRAIN INJURY BLOOD BASED	0	1431	0	0	0	0	0	0
869 T-MED/ADVANCED TECHNOLOGY	4151	3155	3466	3495	3526	3629	3718	3802
870 DOD MED DEF AG INF DIS	24022	27696	14292	15078	15780	15414	15633	16171
873 HIV EXPLORATORY RSCH	10227	0	11238	11356	11808	12074	12081	12075
874 CBT CASUALTY CARE TECH	8529	10317	8953	8379	16353	14016	12113	9239
878 HLTH HAZ MIL MATERIEL	10627	11302	11900	12363	12370	12509	12751	13052
879 MED FACT ENH SOLD EFF	8216	8781	9028	10401	10514	10514	10673	10934
967 DYE TARGETED LASER FUSION	3263	0	0	0	0	0	0	0
968 SYNCH BASED HI ENERGY RADIATION BEAM CANCER DETECT	0	16917	0	0	0	0	0	0
96A EMERGENCY HYPOTHERMIA	2495	2107	0	0	0	0	0	0
96C DIGITAL IMAGING AND CATHERIZATION EQUIPMENT	0	764	0	0	0	0	0	0
96D ENDOBIOLOGICS VACCINATION PROGRAM	0	953	0	0	0	0	0	0
96E HEMORRHAGE CONTROL DRESSING	0	2335	0	0	0	0	0	0
96F PORTABLE BIOCHIP ANALYSIS SYSTEM	0	1715	0	0	0	0	0	0
96G PRE-CLINICAL AND CLINICAL EVALUATION	0	1620	0	0	0	0	0	0

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

96H	RUGGED TEXTILE ELECTRONIC GARMENTS	0	953	0	0	0	0	0	0
96I	REMOTE ACOUSTIC HEMOSTASIS	0	6673	0	0	0	0	0	0
96J	GULF WAR ILLNESS	0	2859	0	0	0	0	0	0
977	EMERGING INFECTIOUS DISEASES	6458	0	0	0	0	0	0	0
MA1	ARTHROPOD-BORNE INFECTIOUS DISEASE CONTROL	2398	2003	0	0	0	0	0	0
MA2	DIABETES PROJECT	4891	0	0	0	0	0	0	0
MA3	MEDICAL AREA NETWORK FOR VIRTUAL TECHNOLOGY	7674	3241	0	0	0	0	0	0
MA4	SPEECH CAPABLE PERSONAL DIGITAL ASSISTANT	958	1906	0	0	0	0	0	0
MA5	CENTER FOR INTERNATIONAL REHABILITATION	1343	3336	0	0	0	0	0	0
MA6	DERMAL PHASE METER	576	1001	0	0	0	0	0	0
MA7	VCT LUNG SCAN	3070	0	0	0	0	0	0	0
MA8	MONOCLONAL ANTIBODY BASED TECHNOLOGY	2878	0	0	0	0	0	0	0
MA9	OPERATING ROOM OF THE FUTURE	2398	2859	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element supports focused research for healthy, medically protected soldiers, and funds research consistent with the "Medical," "Survivability," and "Future Warrior" technology areas of the Objective Force. The primary goal of medical research and development is to sustain medical technology superiority to improve the protection and survivability of U.S. forces on conventional battlefields as well as in potential areas of low intensity conflict and military operations short of war. This program element funds applied research in Department of Defense (DoD) medical protection against naturally occurring diseases of military importance and combat dentistry, as well as applied research for Department of Army care of combat casualties, health hazard assessment of military materiel, and medical factors enhancing soldier effectiveness. This program element is the core DoD technology base to develop methods and materials for infectious disease prevention and treatment including vaccines, prophylactic and therapeutic drugs, insect repellents, and methods of diagnosis and identification of naturally occurring infectious diseases; prevention and treatment of combat maxillofacial (face and neck) injuries, and essential dental treatment on the battlefield; combat casualty care of trauma and burns due to weapons, organ system survival, shock resulting from blood loss and infection, blood preservation, and potential blood substitutes for battlefield care; assessment of the health hazards of military materiel, and the sustainment or enhancement of soldier performance. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan,

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

and Project Reliance. The program element contains no duplication with any effort within the Military Departments. The U.S. Army Medical Research and Materiel Command manage this program. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this program.

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	128798	67476	71682	75359
Current Budget (FY 2004/2005 PB)	122121	124314	58877	61072
Total Adjustments	-6677	56838	-12805	-14287
Congressional program reductions				
Congressional rescissions		-5886		
Congressional increases		66160		
Reprogrammings	-4010	-709		
SBIR/STTR Transfer	-2667	-2727		
Adjustments to Budget Years			-12805	-14287

Change Summary Explanation:

Significant Changes:

FY 2003 - Program responsibility for management and oversight of HIV R&D efforts was transferred to the National Institutes of Health (NIH). FY 2004 – Program was transferred back to the Army.

FY 2004/2005: Funds realigned to higher priority requirements in the medical advanced technology (PE 0603002) to support FCS and Objective Force.

FY03 Congressional adds:

Proj

841 Minimally Invasive Surgery Modeling & Simulation \$2,100

845 Bone Health \$1,050

863 Tissue Engineering Initiative \$2,550

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

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BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

863	Tissue Repair and Replacement for Battlefield Injuries	\$2,500	
865	Center for Military Biomaterials Research	\$1,000	
866	Clinical Trial Utilizing a Piezoelectric Dry Powder Inhalation Device	\$1,700	
867	Diagnostics in Traumatic Brain Injury-Blood Based	\$1,500	
968	Proton Beam Radiation Therapy Program	\$5,000	
968	Synchrotron Based Scanning Research	\$12,750	
96A	Emerg Hypothermia for Adv Cbt Cas and Delayed Resuscitation	\$2,210	
96C	Digital Imaging and Catheterization Equipment	\$800	
96D	Endobiologics Vaccination Program	\$1,000	
96E	Hemorrhage Control Dressings	\$2,450	
96F	Portable Biochip Analysis System for Rapid Detection of Biowarfare Agents	\$1,800	
96G	Preclinical and Clinical Evaluation of High Resolution Mobile Gamma Camera & Position Imaging Devices	\$1,700	
96H	Rugged Textile Electronic Garments for Combat Casualty Care	\$1,000	
96I	Remote Acoustic Hemostasis	\$7,000	
96J	Gulf War Illness	\$1,000	
97W	SEATreat	\$2,000	
MA1	Controlling Mosquito and Tick Trans Dis	\$2,100	
MA3	Medical Area Networks for Virtual Tech	\$3,400	
MA4	Speech Capable Personal Digital Assist	\$2,000	
MA5	International Rehabilitation Network	\$3,500	
MA6	Dermal Phase Meter	\$1,050	
MA9	Operating Room of the Future	\$3,000	

FY03 Congressional Add projects with no R-2As not listed/defined due to space limitations.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
869

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
869 T-MED/ADVANCED TECHNOLOGY	4151	3155	3466	3495	3526	3629	3718	3802

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 Warrior Objective Force Technology Areas. Research efforts focus on developing a wearable, integrated system to determine soldier physiological status. 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. The following US Army Medical Research and Materiel Command laboratories conduct research under this project: the US Army Aeromedical Research Laboratory, the US Army Research Institute of Environmental Medicine, the US Army Institute of Surgical Research, and the Walter Reed Army Institute of Research. Additional contributors include Los Angeles County and the University of Southern California Medical Centers. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
869

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, designed a prototype system for remote detection of a ballistic wounding event. Established a database of human physiological responses associated with severe trauma to provide a tool for judging effectiveness of new treatments. Obtained acoustic signatures associated with a collapsed lung in animal models as a basis for diagnosing a collapsed lung in humans. Developed knowledge management system to reduce complex biological data to essential information about the physiological readiness of soldiers. FY03, evaluate prototype acoustic collapsed lung detector. Design prototype handheld Personal Digital Assistant-based physiological monitor for the medic, and provide final sensor specifications and physiological data management algorithms for monitoring heart rate and breathing, wound detection, heat stress, movement, and sleep. FY04, pursue component technology improvement objectives for metabolic monitoring, including hydration and energy expenditure, and developing body signal processing algorithms and physiological models. FY05, demonstrate ability to noninvasively monitor alertness in real time in operational settings and establish accuracy of pulse velocity as an alternative measure of blood pressure and incorporate into remote triage algorithm for Objective Force Warrior medic.	4151	3155	3466	3495
Totals	4151	3155	3466	3495

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602787A - MEDICAL TECHNOLOGY						PROJECT 870	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
870 DOD MED DEF AG INF DIS	24022	27696	14292	15078	15780	15414	15633	16171

A. Mission Description and Budget Item Justification: This project researches and investigates medical countermeasures to naturally occurring infectious diseases potentially affecting the "Medical" technology area of the Objective Force. Infectious diseases pose a significant threat to operational effectiveness and 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, the bacterial diseases responsible for diarrhea (i.e., caused by Shigella, enterotoxigenic Escherichia coli, and Campylobacter), and viral diseases (i.e., dengue fever and hantavirus). The program also develops improved materiel for control of arthropod disease vectors and addresses a variety of other threats to mobilizing forces, including meningitis, viral encephalitis, and hemorrhagic fevers. Improved diagnostic capabilities are also pursued to enable rapid battlefield identification and management of diseases for which there is no current method of protection. Goals include developing (gene-based) DNA vaccines; incorporating new technologies to enhance effectiveness and duration of vaccines; integrating cutting edge genomic and proteomic (protein-based) technologies into vaccine and drug discovery; developing vaccines that can protect against multiple disease strains and drugs to treat malaria; and increasing vaccine safety and efficacy. Intramural research under this project is conducted at the US Army Medical Research and Materiel Command's US Army Medical Research Institute of Infectious Diseases, the Walter Reed Army Institute of Research and its overseas laboratories, and the Naval Medical Research Center and its overseas laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
870

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, continued efforts to develop a vaccine to protect the warfighter against the falciparum and vivax malaria parasites, the two most lethal forms of malaria; evaluated new technologies such as experimental vaccine additives that can increase effectiveness of malaria vaccines and initiated preclinical testing of these in animals. FY03, evaluate candidate DNA vaccines as a part of a multicomponent vaccine; complete preclinical testing of a liver stage malaria vaccine. FY04, produce malaria parasites for use in clinical challenge studies and test development; generate virus-based vaccines; conduct safety and protection studies; FY05, test DNA and protein vaccine candidates in preclinical trials for inclusion into multicomponent malaria vaccine.	5940	7905	4588	5508
FY02, evaluated a combined antidiarrheal vaccine candidate that can protect against Shigella-based diarrheas and a hybrid Shigella-Enterotoxigenic Escherichia coli (ETEC) vaccine in animals. FY03, construct an improved Shigella flexneri candidate vaccine; conduct preclinical studies of Campylobacter vaccine; complete combined Shigella-ETEC vaccine study, and produce clinical-grade lots of candidate vaccine for testing. FY04, refine animal model and conduct preclinical testing of candidate vaccines to support investigational new drug application to the Food and Drug Administration (FDA). FY05, formulate a mixed component vaccine to provide broad protection against bacterial diarrheal diseases to the warfighter.	4414	5945	2742	2600
FY02, conducted toxicological studies of candidate insect repellent; evaluated a candidate repellent for improved protection and reduced toxicity; and conducted preliminary tests of system for controlling insects carrying dengue virus. FY03, select new repellent; continue field study of the dengue vector control system. FY04, perform final evaluation of repellent with human volunteers; FY05, complete testing of a dengue vector control system.	2050	2253	1524	1297
FY02, broadened protection of scrub typhus vaccine candidates based on gene sequencing efforts. Determined that a vaccine with only five selected strains of scrub typhus will provide protection against the hundreds of known strains. FY03, develop a second animal model required for safety testing and initiate vaccine testing. FY04, complete animal safety and protection studies. FY05, compile preclinical data to justify FDA Phase 1 trials of single strain vaccine to demonstrate safety and response to vaccine in humans.	2000	2138	1094	999

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
870

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
FY02, improved the effectiveness of candidate dengue fever DNA vaccines and the ability to measure immunity generated by the vaccine; engineered two candidate Group B strain bacterial meningitis vaccines; completed preclinical testing of a candidate hantavirus DNA vaccine to protect against Hemorrhagic Fever with Renal Syndrome (HFRS) in compliance with FDA; and constructed a vaccine against Rift Valley fever. FY03, prepare and evaluate dengue vaccines for FDA clinical trials; complete genetic engineering of three group B meningitis strains; prepare for Phase 1 clinical trials for HFRS vaccine. FY04, select the most promising new dengue vaccines from clinical trials and improve as needed; perform preclinical trial of a meningitis vaccine. FY05, complete construction of the second vaccine component to provide complete protection against HFRS, submit investigational new drug application to test new component for an improved meningitis vaccine; conduct preclinical testing of improved dengue vaccines.	6618	6126	2311	2339
FY02, selected the Artesunate drug for further development to treat severe malaria. Performed animal toxicology tests on additional new antimalarial drugs to treat and protect against malaria. FY03, conduct preclinical studies of new drugs to prevent malaria; complete preclinical toxicology testing of new drug to treat severe malaria and submit investigational new drug application for clinical testing, develop animal models that better predict human safety and continue to test new classes of drugs for antimalarial activity. FY04, select best drug candidates for preclinical and clinical studies. FY05, perform toxicological studies of new drug candidates.	3000	3329	2033	2335
Totals	24022	27696	14292	15078

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
873

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
873 HIV EXPLORATORY RSCH	10227	0	11238	11356	11808	12074	12081	12075

A. Mission Description and Budget Item Justification: This project supports the "Medical" technology area of the Objective Force by conducting applied research and development of improved diagnostics, surveillance and epidemiology, candidate vaccines, and promising drugs for prevention and treatment of human immunodeficiency virus (HIV). Main efforts include construction and pre-clinical 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. Research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Walter Reed Army Institute of Research and its overseas laboratories, and the Naval Medical Research Center and its overseas laboratories. Most work is conducted under a cooperative agreement with the Henry M. Jackson Foundation, Rockville MD. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
873

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>FY02; continued surveillance of HIV-1 subtype emergence and spread in South and Central America, Eastern Europe, and parts of Asia which are regions of current or potential deployment. Characterized the occurrence of HIV and the immune response to it in multiple populations in projected vaccine study areas. Optimized sensitive, specific, reproducible, high-throughput assays for assessment of individuals immunized with HIV vaccines and for pre-clinical evaluation of HIV vaccines in non-human primates and rodents. Supported the development of international laboratories for HIV studies at associated medical centers and hospitals. Continued studies of HIV-1 infections in U.S. military health care beneficiaries in a multi-center study. FY03 HIV program transferred to NIH. FY04/05, HIV program returned to the Army. Construct additional candidate vaccines that induces a broader anti-HIV immune responses against HIV subtypes found outside the United States and important in military deployments. Continue genetic analysis of HIV subtypes isolated in Africa for integration into vaccine candidates for this region. Develop HIV vaccine study populations for future field trials in Kenya, Uganda, Tanzania and Cameroon. Support global surveillance of HIV-1 to (a) target international HIV-1 vaccine development and (b) inform the U.S. military of the HIV threat in areas of potential troop deployment through the existing network of overseas collaborators, with special attention to surveillance in Eastern Europe and countries of the former Soviet Union. Maintain U.S. Military Clinical Intervention Network that is operated through Military Medical Treatment Facilities to study the frequency and impact of HIV/AIDS in/on military populations, especially when consequent to troop deployments. Identify cost effective drugs and care strategies to control HIV infection and transmission in military populations.</p>	10227	0	11238	11356
Totals	10227	0	11238	11356

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602787A - MEDICAL TECHNOLOGY						PROJECT 874	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
874 CBT CASUALTY CARE TECH	8529	10317	8953	8379	16353	14016	12113	9239

A. Mission Description and Budget Item Justification: This project investigates potential treatments for weapons-induced trauma and shock because of 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. Applied research in combat casualty care focuses on the evaluation of feasibility of concepts 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 include blood products; resuscitation fluids; drugs and devices to control severe bleeding; methods to minimize, repair, and prevent injury; and diagnostic and predictive indicators for remote triage and computerized, autonomous patient care. Additional goals are to reduce evacuations due to dental disease and reduce the medical footprint on the battlefield. Internal research under this project is conducted at the US Army Medical Research and Materiel Command's US Army Institute of Surgical Research, and the Walter Reed Army Institute of Research. Major contractors include the University of Washington, Seattle, Washington; the State University of New York at Buffalo, and Monterey Biomedical, Inc., Scotts Valley, California. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
874

Accomplishments/Planned Program

	FY 2002	FY 2003	FY 2004	FY 2005
<p>FY02, refined the plasma freeze-drying process to reduce field logistical load; designed and tested a prototype device to detect blood-borne infectious diseases to improve transfusion safety; evaluated commercially available resuscitation fluids for best effect in animal models; evaluated methods to reduce inflammatory response and improve survival after resuscitation of animals with severe blood loss. FY03, conduct animal testing of freeze-dried plasma; refine freeze-drying process for red blood cells to replace refrigerated red blood cells on the battlefield; begin studies in animal models of the impact of low-volume fluid resuscitation on survival and outcome after severe blood loss. FY04, conduct manufacturing and testing of pilot lots of freeze-dried plasma and novel storage containers; submit investigational new drug application for freeze-dried plasma, conduct animal testing of freeze-dried plasma. FY05, submit investigational new drug (IND) application for freeze-dried plasma, prepare for clinical testing of freeze-dried plasma, complete studies of low-volume fluid resuscitation, identify new candidate chemical additives for resuscitation fluids to improve outcome of resuscitated casualties.</p>	2678	3812	3132	2932
<p>FY02, developed animal models to study safety and effectiveness of drugs to control severe bleeding; conducted animal studies of candidate drugs to restore blood clotting in casualties with abnormal clotting. FY03, conduct research on a device to control severe bleeding without a tourniquet; continue development of a handheld device to stop bleeding with sound waves in animals; conduct follow-on animal studies of candidate drugs to restore blood clotting. FY04, initiate animal studies of candidate drugs to evaluate potential to restore blood clotting in casualties that have abnormal clotting to increase survival of battlefield casualties. FY05, complete animal studies of candidate drugs to evaluate their potential to restore blood clotting in casualties that have abnormal clotting, submit investigational new drug application for candidate drug to restore blood clotting function.</p>	2278	2100	1610	1447

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
874

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
FY02, demonstrated effectiveness in animal models of antimicrobial cement and antimicrobial fixator pins to prevent bone infection after fracture repair; conducted animal studies to mitigate effects of smoke inhalation in combat casualties; evaluated already licensed drugs for safety and effectiveness in treating penetrating brain injury; tested a new device to measure intracranial pressure after head injury. FY03, study new methods to manage and mitigate injuries caused by land mines and shrapnel weapons; investigate newly licensed drugs for stroke to mitigate effects of traumatic brain injury. FY04, conduct initial studies of an antimicrobial wound-cleaning device, conduct initial studies of lightweight materials and splints for fracture stabilization, evaluate candidate neuroprotective drugs in cell culture and in an animal model of brain injury. FY05, down-select and conduct clinical testing of an advanced prototype wound protective barrier device, submit an investigational device exemption application (IDE) for a prototype wound protective barrier device, continue studies in animal models of the effectiveness of candidate drugs to mitigate brain injury after head trauma.	2007	2000	1911	2100
FY02, designed and tested micro-impulse radar (MIR) as a means to monitor life-signs in casualties; conducted toxicity studies of candidate chemical food additives for preventing dental disease in deployed warfighters. FY03, seek methods to mitigate the effects of body and vehicle motion on accuracy of MIR; conduct preclinical studies of a candidate chemical additive for meals ready to eat (MREs) for prevention of dental disease. FY04, continue to conduct preclinical studies of a candidate chemical additive for MREs; adapt handheld MIR to a wearable version. FY05, continue to conduct preclinical studies of a candidate chemical additive for MREs for prevention of dental disease; transition handheld MIR for heart rate monitoring to System Development and Demonstration.	1566	2405	2300	1900
Totals	8529	10317	8953	8379

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602787A - MEDICAL TECHNOLOGY						PROJECT 878	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
878 HLTH HAZ MIL MATERIEL	10627	11302	11900	12363	12370	12509	12751	13052

A. Mission Description and Budget Item Justification: This supports "Medical" and "Survivability" Objective Force Technology Areas 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. 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. Intramural research is conducted at the US Army Aeromedical Research Laboratory, the US Army Research Institute of Environmental Medicine, and the Walter Reed Army Institute of Research. Major contracts are with Universal Energy Systems and JAYCOR. Additionally, numerous Cooperative Research and Development Agreements are held with universities and independent laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

Accomplishments/Planned Program	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
FY02, identified, through micro gene array techniques, promising candidate pharmaceuticals to minimize laser eye injuries. FY03, evaluate drugs to minimize secondary nerve injury from battlefield lasers and refine exposure limits to minimize laser eye injury hazards. FY04, test genomic/proteomic (study of protein expression and function) derived laser eye injury treatments in non-human primates. FY05, develop laser eye injury triage, treatment and protection applications.	2326	3520	3821	4212

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
878

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
FY02, established and tested standard methodologies for evaluating restraint technologies to enhance soldier safety in tactical vehicles and aircraft. Developed model of aircrew airbag interaction in helicopter crashes. Completed an approved Draft International Standard on evaluating human response to repeated mechanical shock. FY03, define injury thresholds for dynamic responses in restraint systems for Army ground and air vehicles. FY04, provide validated repeated jolt guidelines and proposed standards for safe operations of tactical ground vehicles for use in the Health Hazard Assessment program. Provide performance standards for effective military restraint systems. FY05, translate validated restraint and jolt standards into a biomedically valid virtual prototyping model.	1215	1249	1344	940
FY02, designed a device to characterize forces behind body armor and initiated blunt trauma injury studies. FY03, fully characterize forces behind soft and hard body armor and initiate a mathematical model to analyze and validate data from animal injury studies. FY04, complete animal injury studies, analyze and validate data, and develop test module for body armor developers. FY05, design human injury prediction software to facilitate development of advanced body armor that protects soldiers from potentially lethal blunt trauma injuries.	3737	3718	3920	3817
FY02, identified indicators of reproductive effects using genomic (study of genes and their functions) and proteomics (study of protein expression and function) technologies to provide faster and more comprehensive assessment of toxicological hazards. FY03, design neurotoxicity and reproductive toxicity tests for evaluating militarily relevant chemicals and mixtures. FY04, study approaches for a portable aquatic biomonitor for monitoring chemical contamination in water. FY05, apply proteomics-based findings to establish initial concepts for simple and reliable field neurotoxicity analysis.	3349	2815	2815	3394
Totals	10627	11302	11900	12363

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602787A - MEDICAL TECHNOLOGY						PROJECT 879	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
879 MED FACT ENH SOLD EFF	8216	8781	9028	10401	10514	10514	10673	10934

A. Mission Description and Budget Item Justification: This supports "Medical" and "Survivability" technology areas of the Objective 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 forms 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. Research under this project is conducted at the US Army Aeromedical Research Laboratory, the US Army Research Institute of Environmental Medicine, and the Walter Reed Army Institute of Research and its overseas laboratories. Major contract is with JAYCOR. Additionally, numerous Cooperative Research and Development Agreements are held with universities and independent laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, transitioned compatible model for measuring effects of extreme cold climate related stress and performance to Scenario, the Army's simulation model. Studied melatonin effects on mental ability, temperature regulation, and performance. FY03, establish neural network model, test dehydration component of model, and validate terrain coefficients in the model. FY04, complete the model of cold, heat, and altitude stress to predict individual and unit level performance outcomes based on environmental and operational variables. FY05, integrate temperature regulation and sleep models into the Scenario model.	2000	2030	2216	2530
FY02, demonstrated effectiveness of resynchronizing drugs to decrease jetlag following rapid deployment operations. Determined effectiveness of caffeine gum in regular and periodic users. FY03, provide guidance on using caffeine, modafinil, and amphetamines to fight fatigue. FY04, establish a sleep model that predicts the effects of stimulants and naps on performance. FY05, demonstrate a comprehensive fatigue and performance model for group predictions of soldier performance in continuous operations.	2248	2818	1610	2123

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

PROJECT
879

<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
FY02, identified stressors associated with military deployments to improve soldier resiliency and performance, and determined that deployment tempo significantly impacts the health of the military family. FY03, develop a tool to assess cognitive function in the field and develop an Army-wide suicide surveillance system. FY04, identify factors that predict high rates of mental disorders and define the association of mental health with readiness. FY05, propose effective methods for psychological health screening in deployed troops.	2100	2187	3071	3595
FY02, developed a preliminary version of the shades-of-gray model to assess visual performance with head-mounted devices. FY03, establish visual performance criteria for the integration of flat panel displays into helmet-mounted devices. FY04, determine the effect of eyesight correction on visual performance with electro-optical devices and complete visual detection model to include complex targets and backgrounds. FY05, provide guidance on safety and effectiveness of laser eye surgery for vision correction to eliminate the need for glasses.	1868	1746	2131	2153
Totals	8216	8781	9028	10401

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603001A - Warfighter Advanced Technology

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	59815	57014	63882	68763	71439	56567	84170	84775
242 AIRDROP EQUIPMENT	3777	3398	8668	7428	4017	4093	4183	4279
393 MIL OPS IN URBAN TERRAIN (MOUT)	13309	0	0	0	0	0	0	0
543 AMMUNITION LOGISTICS	771	775	950	1565	1512	1446	1481	1515
545 FORCE PROJECTION LOGISTICS	0	7107	0	0	0	0	0	0
557 BIOSYSTEMS TECHNOLOGY	4125	4098	0	0	0	0	0	0
594 METROLOGY & CALIB	963	953	0	0	0	0	0	0
C07 JOINT SERVICE COMBAT FEEDING TECH DEMO	2161	2215	2238	2341	2430	2488	2525	2586
J50 FUTURE WARRIOR TECHNOLOGY INTEGRATION	34709	38468	52026	57429	63480	48540	75981	76395

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 (O&S) costs; and improving ammunition logistics system performance. This PE contains several projects. The major effort in the Future Warrior Technology Integration project (J50) is Objective Force Warrior (OFW), an integrated soldier system of systems providing the next generation of capabilities beyond Land Warrior Blocks I and II. A competitive multiple contractor strategy has been implemented to foster innovation and reduce risk of bringing enhanced capabilities to the warfighter. OFW will provide a lightweight, stealthy armored suit, integrated with multi-functional sensors, weapons and proactive medical capabilities. The OFW will have connectivity to other dismounted personnel, Future Combat Systems (FCS), and robotic air/ground platforms for improved situational understanding and effects. The intent of OFW is to provide the dismounted soldier with combat overmatch capabilities for the full spectrum of Objective Force missions. The Military Operations in Urban Terrain (MOUT) project (393) consists of two Advanced Concept Technology Demonstrations (ACTD); the MOUT ACTD completed in FY02 and a second effort that continues in partnership with DARPA to develop a robotic Micro Air Vehicle (MAV) for urban and complex environments. The MAV ACTD will supply a close-in, real-time surveillance capability for small units, thereby reducing the operational and tactical risks associated with small unit operations. 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 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 Force Projection Logistics project (545) demonstrates embedded training simulations to support vehicle crews and mature logistics simulations that relate combat performance to logistics requirements.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603001A - Warfighter Advanced Technology

The funding for project 545 will be realigned to newly established PE 0603015A in FY 2004. The Airdrop Equipment project (242) provides enhancements to rapid deployment and force projection capability by maturing and demonstrating technology required for dropping cargo to precise locations from higher altitudes, greater offset distances and higher speeds. The objective is increased survivability of aircraft and crews, and increased probability that materials delivered will land in a usable condition. This PE supports the Army Transformation in the areas of improved dismounted soldier capabilities (projects J50 and 393), logistics footprint reduction (projects C07, 543 and 545) and rapid deployment (project 242). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program adheres to Tri-Service Reliance Agreements on clothing, textiles, food, and explosive ordnance disposal with oversight and coordination provided by the Joint Directors of 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). This PE contains no duplication with any effort within the military departments. Work is performed by the Natick Soldier Center; the Armament Research, Development, and Engineering Center; the Aviation and Missile Command; and the Provisional Research, Engineering, and Development Command. It supports the transition path to the Objective Force described by the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	62089	50262	85024	69911
Current Budget (FY 2004/2005 PB)	59815	57014	63882	68763
Total Adjustments	-2274	6752	-21142	-1148
Congressional program reductions		-3500		
Congressional rescissions		-1281		
Congressional increases		13400		
Reprogrammings	-637	-328		
SBIR/STTR Transfer	-1637	-1539		
Adjustments to Budget Years			-21142	-1148

Significant Changes:

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February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603001A - Warfighter Advanced Technology

FY04: Funds realigned to newly established PE 0603015A in FY04.

FY05: Funds realigned to higher priority requirements.

FY03 Congressional Adds:

FY03 – Congressional adds were made for Metrology, Project 594 (\$1000); Biosystems Technology, Project 557 (\$4300); Scorpion Future Combat Helmet, Project J50 (\$5600); Personal navigation of the future warfighter, Project J50 (\$2500)

FY03 Congressional Reduction: Objective Force Warrior, Project J50 (-\$3500)

Projects with no R-2A:

(\$7107), Force Projection Logistics, Project 545: Demonstrates embedded training simulations to support vehicle crews. The project also matures logistics simulations that relate combat performance to logistics requirements to demonstrate the effect of strategic policy and decisions on the size, cost, and effectiveness of the deployed force.

Funding realigned to newly established PE0603015A in FY04.

(\$4098), Biosystems Technology, Project 557: The objective of this Congressional add is to demonstrate biosystems technologies with potential for military applications. No additional funding is required to complete this project.

(\$953), Metrology, Project 594: The objective of this Congressional add is to demonstrate and analyze standards for aerosol particles, microwave, and radiation calibration systems. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603001A - Warfighter Advanced Technology	PROJECT 242						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
242 AIRDROP EQUIPMENT	3777	3398	8668	7428	4017	4093	4183	4279

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 as envisioned in the Army Vision for the Objective 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 decelerator, guidance and sensing (e.g., Global Positioning System (GPS)), and wind sensing technologies, precision airdrop systems have the ability to be deployed from high altitudes (up to 25,000 ft) and to deliver payloads with better accuracy, i.e. a 100 meter Circular-Error-Probable (CEP). Capabilities envisioned are delivery of up to 10,000 lbs. from 15 to 20 miles offset and extended range delivery of 500-2000 lbs. from 100 km offset (using powered glide augmentation), both with 100 meter CEP accuracy. An effort to increase the payload weight to 26,000 lbs for the same offset distance and altitude will begin in FY04. Delivery from high altitudes and large offset distances improves cargo, personnel, and aircraft survivability. The efforts in this project support the Army Transformation in the area of rapid deployment. This project is managed by the US Army Natick Soldier Center, Natick, MA. This project supports the transition path to the Objective Force in the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603001A - Warfighter Advanced Technology	PROJECT 242
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Aerial delivery of cargo - In FY02, conducted system-level soft landing technology testing for a roll-on/roll-off capability for 15,000-20,000 lb payload . Designed and evaluated (radio controlled) a 1/4-scaled prototype high altitude parachute control system. In FY03, demonstrate the system for a roll on/roll-off capability for 15,000-20,000 lb payload providing a 60% decrease in labor intensive rigging; transition technology to PM Force Sustainment for System Development and Demonstration. Design full-size prototype and test (autonomous controlled) a 1/4 scaled prototype high altitude parachute control system. Design and plan test of 10,000 lb. autonomous offset "just-in-time" resupply airdrop system prototype. In FY04, perform component level evaluations and system modeling for the high altitude parachute control system prototype. Perform component level evaluations and system modeling for the autonomous, offset, "just-in-time" resupply airdrop system prototype. Demonstrate autonomous, offset airdrop (up to 20 miles) up to 10,000 lbs and transition to PM-Force Sustainment for System Development and Demonstration. In FY05, demonstrate controllable cargo parachutes with 10,000 lb. loads from high altitude and with complete autonomous control and transition to PM-Force Sustainment for System Development and Demonstration. Perform component-level evaluations and system modeling for Objective Force heavy precision airdrop (20-ton) system.	2814	3398	3813	2200
Heavy Precision Airdrop - In FY04, Complete component modeling for Objective Force heavy precision airdrop (26,000 lbs) system. In FY05, Perform component-level evaluations and begin system modeling for Objective Force heavy precision airdrop system.	0	0	4855	4728
Personnel Parachute Technology – In FY05, demonstrate technology for a static line parachute automatic opening capability providing 100% detection of total malfunctions and transition technology to PM–Soldier Equipment for System Development & Demonstration.	0	0	0	500
This one year Congressional add demonstrated pneumatic muscle soft landing technology for heavy equipment airdrop systems. No additional funding is required to complete this project.	963	0	0	0
Totals	3777	3398	8668	7428

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603001A - Warfighter Advanced Technology						PROJECT 543	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
543 AMMUNITION LOGISTICS	771	775	950	1565	1512	1446	1481	1515

A. Mission Description and Budget Item Justification: This project develops technology that provides rapid munitions deployability, resupply, and rearm for the Army's Objective 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. One major effort, Remote Readiness Asset Prognostics Diagnostics System (RRAPDS) demonstrates an integrated system that provides "health status" information on critical high value munitions to ensure safety and reliability. The system integrates low power environmental micro-sensors, data storage, and on-board prognostics & diagnostics to monitor munitions throughout their lifecycle into an affordable device. A second major effort will demonstrate an automated rearm and resupply capability for the Future Combat System (FCS) Multi-Role Armament and Ammunition System (MRAAS). The rearm/resupply capability contains "plug-in" ammunition modules or clips and an automated upload mechanism that will enable rapid "pit-stop" resupply operations by providing 2.5X faster rearm. This project is managed by the U.S. Army Armament Research, Development, and Engineering Center, Picatinny Arsenal, NJ. Technology will transition to weapons and munitions development programs for weapons, munitions, MHE, and tactical vehicles. This project supports the transition path to the Objective Force described by the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
RRAPDS - In FY02, completed demonstration of prototype systems that capture a complete 3-axis shock and temperature history over the course of an entire munitions shipment and wirelessly feed data to Army management information systems for local and remote command center access.	418	0	0	0
Automated Rearm and Resupply Capability for the FCS MRAAS - In FY02, developed design concepts for ammunition modules and the automated upload mechanism. In FY03, complete preliminary design of ammunition modules and automated upload mechanism. In FY04, complete design integration with autoloader. In FY05, fabricate prototype modules and upload mechanism and conduct system testing.	353	775	950	1565
Totals	771	775	950	1565

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603001A - Warfighter Advanced Technology						PROJECT C07	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
C07 JOINT SERVICE COMBAT FEEDING TECH DEMO	2161	2215	2238	2341	2430	2488	2525	2586

A. Mission Description and Budget Item Justification: The Joint Service Combat Feeding Technology Demonstration 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 demonstrates advances in combat rations technology, materials, energy utilization, and heating technologies to provide efficient and effective field feeding with reduced resupply. 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 modeling and simulation for predictive models 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 technology that will reduce the logistics of field feeding by over 75% (in component parts, weight, cube, fuel and water) and labor requirements by 50%, while improving the quality of food service. This project is a DoD program for which the Army has Executive Agent responsibility and is managed by the U.S. Army Natick Soldier Center, Natick, MA. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603001A - Warfighter Advanced Technology

C07

Accomplishments/Planned Program

	FY 2002	FY 2003	FY 2004	FY 2005
Equipment and Energy Technologies – In FY02, fabricated 20 Remote Unit Self Heated Meal (RUSHM) prototypes and conducted initial technology demonstrations. In FY03, integrate optimized packaging, heater, and food for the RUSHM prototype and complete final demonstrations, showing logistical reductions and new capability to sustain the warfighter in remote locations (90% reduction in manpower, weight and cost). Integrate Field-feeding and Advanced Sustainment Technology (FAST Food Service) subsystems including co-generator, appliance heat exchangers, steam generator, control system, heat driven refrigeration, compact insulated food containers, and water recycling sanitation system. Demonstrate a co-generator for legacy kitchens that reduces kitchen fuel consumption by 50% and noise by at least 10dB. In FY04, conduct multi-service demonstrations of FAST Food Service, validate metrics. In FY05, demonstrate durable nonstick coatings to improve cleanability and lower operation/support costs for cookware; transition to 6.4.	342	580	1038	449
Technologies for Novel Ration Preservation & Stabilization, Revolutionary Packaging and Food Safety – In FY02, demonstrated novel preservation/stabilization technologies, such as, non-foil packaging for microwave/radio frequency sterilized ration components, compressed meal components to reduce size/weight, and passive/non-passive shelf-life extension for fresh fruits/vegetables. Utilized modeling/simulation tools to increase ration quality/variety while reducing the logistics footprint by up to 65%. In FY03, mature novel preservation/stabilization capabilities that were demonstrated in FY02. Conduct limited field demonstration for an integrated ration monitoring, inventory and tracking system as part of a computer based Global Asset Visibility System. In FY04, conduct producibility tests for novel shelf-stable breakfast items to expand menu variety, while enhancing ration acceptance/consumption. Fabricate and conduct technical demonstration of a surface scanning biosensor. 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 for food safety testing in combat field feeding systems and in military dining facilities. Demonstrate nanocomposites, ultra-high barrier polymers, barrier films, and films with chromatic pigments, to extend quality/shelf-life of combat rations, reduce their weight/signature, and minimize environmental impact.	1023	1044	503	1488

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603001A - Warfighter Advanced Technology

C07

Accomplishments/Planned Program (continued)

Technologies for Nutrients and Novel Delivery Systems – In FY02, demonstrated: processing technologies for novel nutrient delivery systems for mission-targeted warfighter performance including a First Strike Ration (FSR) system; enhanced prototypes for extended reconnaissance flight feeding; and performance enhancing gels. Applied modeling/simulation technologies to demonstrate the influence of nutritional initiatives on mission effectiveness. In FY03, transition to 6.4 mature novel nutrient delivery and packaging system for specialized rations to improve consumption, and reduce weight/volume. Conduct limited field evaluation of FSR in various operational Objective Force Warrior (OFW) scenarios (Army SOF/Marines). Conduct prototype scale-up of dairy bars and test bars with increased levels of omega-3 fatty acid; finalize bar design. Demonstrate a suite of models based on energy expenditure, physical fatigue, and rehydration rates to measure soldier performance and mission accomplishments. In FY04, demonstrate production scale-up capability and incorporate shelf stable meat/vegetable bars and gels in FSR. Conduct limited FSR field test in various operational OFW scenarios (Army SOF /Marines) incorporating packaging and component modifications with a goal of 50% reduction in cube/weight, as compared to the MRE. In FY05, determine bio-availability and conduct field tests of components with encapsulated protein. Conduct field demonstration to quantify the effects of glucose modulating components on increasing warfighter performance and demonstrate production scale up capability of these components.

FY 2002	FY 2003	FY 2004	FY 2005
796	591	697	404
2161	2215	2238	2341

Totals

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603001A - Warfighter Advanced Technology					PROJECT J50			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
J50 FUTURE WARRIOR TECHNOLOGY INTEGRATION	34709	38468	52026	57429	63480	48540	75981	76395	

A. Mission Description and Budget Item Justification: This project matures and demonstrates leap-ahead technologies and systems for the Objective Force Warrior (OFW), with emphasis on systems integration and multi-functionality to enhance and improve warfighting capability while reducing soldier load. This effort provides the Unit of Action's dismounted soldier the same combat-overmatch, skip-a-generation approach that the Future Combat Systems (FCS) bring to the Maneuver portion of the Objective Force. OFW will employ open system architectures and high-risk/high payoff technologies to yield a lightweight full spectrum integrated protective combat ensemble, integrated with 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. The project will also leverage squad relevant FCS unmanned systems (e.g. Mule) and demonstrate mission packages tailored to the squad. The goal is to achieve leap-ahead advances over Land Warrior Blocks I and II in the areas of survivability, networked communications, individual soldier and small team lethality, and agility - to provide dismounted warfighters in the Objective Force Unit of Action with significant overmatch capability, and enable them to operate for extended periods under arduous combat conditions, with minimal loss in physical capabilities from fatigue, stress, and hardship. This soldier system-of-systems will have connectivity to other dismounted personnel, Objective 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 OFW Concept and Technology Development (CTD) program (FY02-06) will have two (2) competing industry teams develop initial OFW concepts for all Objective Force Unit of Action soldiers; downselect to a single contractor team to conduct OFW technology design and development of the dismounted variant; and culminate with a comprehensive system-of-systems capstone demonstration. Key performance goals are to demonstrate a system with fighting load of no more than 50 lbs per warfighter; the ability to operate for 24 hrs autonomously at the individual level and 72 hrs at the Unit of Action level; and integration with Warfighter Information Network-Tactical/Joint Tactical Radio System. To achieve these goals, future warrior projects and other relevant supporting Army projects have been redirected to achieve the desired capability within the decade. The project will mature and integrate soldier technologies transitioned from 0602786A. This project will leverage the Army's FCS and Joint Tactical Radio System Squad Level Communications programs, as well as other Army S&T and DoD programs to the maximum extent, in order to maximize return on investment to the Army. This project also will mature and demonstrate advanced technology solutions to complex systems integration problems in the areas of multifunctional integrated head-to-toe combat ensembles (Scorpion) during FY2003. The US Army Natick Soldier Center, Natick, MA manages this project. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603001A - Warfighter Advanced Technology		J50	
<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Concept Development (CD) Phase – In FY02, conducted visioning exercises with Army and other DoD leadership, academia and industry to establish realm of possible capabilities for the OFW in light of technology readiness and program timelines. Solicited for and awarded two Other Transaction Agreements for competitive Lead Technology Integrators (LTI) to execute the CD Phase of the OFW program. Established and implemented robust systems engineering, Integrated Product & Process Design, and software engineering processes and principles to execute the program. In FY03, develop soldier system of systems architectures for all Objective Force Unit of Action soldiers, which are compatible with the FCS architecture and Army concepts of operations. Perform trade-off analyses, technology surveys, and technology assessments underpinned with analytical modeling and simulation. Define specific technology projects required to meet technology goals within the timelines of the OFW Concept and Technology Development (CTD) effort. Define interfaces to Objective Force systems and develop system level requirements. Develop two mock-up prototype sets of systems to physically represent the OFW system of systems concepts. Downselect to a single LTI to execute the Technology Integration Phase of the OFW CTD program.	24212	3838	0	0
Technology Integration Phase - In FY03, begin design of dismounted soldier variant incorporating a set of core technologies common to all Unit of Action soldiers. Allocate system level and interface requirements to subsystems and critical components. Execute a design process that incorporates spiral development, virtual prototyping, component breadboarding, breadboard testing, user assessments, modeling and simulation. Evaluate and assess preliminary design prior to initiation of the detailed design effort, and schedule purchase of critical long lead items. Evaluate and assess FCS systems that require interfaces with OFW. In FY04-05, refine and synthesize the requirements at the system, subsystem, and component levels. Execute the detailed design incorporating a spiral development process, virtual prototyping, component and subsystem brassboard evaluation, user assessments, and modeling and simulation. Secure FCS robotic platforms to support OFW demonstration. Conduct limited objective experiments in simulated environments to validate subsystem/component performance. Develop and document a system of systems training and demonstration plan and begin preparation for the demo. Fabricate 2-4 sets of prototype systems and establish a process for fabricating 18-25 systems.	0	22554	52026	35217
Build and Demonstration Phase - In FY05, procure materials, refine fabrication processes, and begin fabrication of 18-25 sets of prototype OFW systems. Fabricate mission packages for use with FCS robotic platforms. Refine the demonstration plans to include tactical experimentation in simulated operational environments, including assessment of interoperability with FCS and other Objective Force systems. Make preparations for FY06 experiments and demonstration.	0	0	0	22212

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603001A - Warfighter Advanced Technology

J50

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
<p>Multifunctional Head-to-Toe Combat Ensemble Subsystem - In FY02, developed five innovative design concepts and system mock-ups of integrated, multi-functional combat ensembles, and three concepts and mock-ups of integrated headgear systems. Explored a variety of integration and design methods to address prioritized user needs developed by soldiers. Investigated connector interfaces for textile based data/power buses, sensors, and/or miniaturized electronics for integration into a personal body local area network for future soldier systems. Initiated development of meso-scale vapor compression cooling prototypes, elastomeric selectively permeable membranes, and multiple visual camouflage patterns for assessment of efficacy in multiple combat environments (i.e. woodland, desert, Military Operations in Urban Terrain (MOUT), day, night). Performed technology assessments and projections to conceptualize an open architecture for the OFW combat ensemble to allow for technology upgrades and mission tailorability. Conducted user juries and technical/user subject matter expert evaluations of the concepts and mock-up prototypes. Provided concepts to the OFW LTI teams as the starting point for the broader OFW Phase I Systems Architecture analysis. In FY03, mature concepts to the greatest extent possible as risk reduction for the OFW CTD Technology Integration Phase. Conduct early technology demonstration with troops in field environments. Continue multi-functional material technology integration for combat ensemble applications. Transition technologies, design concepts, and analyses to the OFW LTI teams.</p>	7137	4348	0	0
<p>Personal Warfighter Navigation (Congressional add) : In FY02, developed Microelectromechanical System (MEMS)/Inertial Navigation System/Global Positioning System with application to ground troops. In FY03, develop enhanced sensor fusion performance in situations where signal is lost (e.g. under canopies or in buildings). Conduct an initial demonstration to assess system attributes. No additional funding is required to complete this project.</p>	2400	2385	0	0
<p>Portable Cooling System: This one year Congressional add developed and demonstrated a portable apparel cooling system. No additional funding is required to complete this project.</p>	960	0	0	0
<p>Scorpion Future Combat Helmet: This one year Congressional add will develop a chem./bio respiratory subsystem, Ballistic protective materials, and thermal management subsystems for integration into a combat helmet. No additional funding is required to complete this project.</p>	0	5343	0	0
Totals	34709	38468	52026	57429

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BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	169598	166406	35168	38686	47368	52063	59897	57469
800 TELEMEDICINE TESTBED	1596	1895	1985	2054	3908	4384	4490	4591
804 PROSTATE CANCER RSCH	0	1001	0	0	0	0	0	0
810 IND BASE ID VACC&DRUG	8410	8772	18156	19955	20301	21799	22312	22836
814 NEUROFIBROMATOSIS	20145	19063	0	0	0	0	0	0
815 NATIONAL MEDICAL TESTBED	7388	0	0	0	0	0	0	0
818 ADVANCED CANCER DETECTION CTR	0	4765	0	0	0	0	0	0
819 FLD MED PROT/HUM PERF	534	545	1450	1614	1654	1683	1724	1763
840 COMBAT INJURY MGMT	4949	5846	13577	15063	21505	24197	31371	28279
929 ARTIFICIAL LUNG TECHNOLOGY	0	953	0	0	0	0	0	0
941 DIABETES RESEARCH	8827	10532	0	0	0	0	0	0
945 BREAST CANCER STAMP	1541	0	0	0	0	0	0	0
969 ALCOHOLISM RESEARCH	5372	3336	0	0	0	0	0	0
972 LASER VISION CORRECTION	2878	0	0	0	0	0	0	0
973 RECOMBINANT VACCINE RESEARCH	0	1906	0	0	0	0	0	0
974 SMART AORTIC RESEARCH	958	0	0	0	0	0	0	0
975 PROTECTION AGAINST EMERGING INFECTIOUS DISEASES	3838	0	0	0	0	0	0	0
97A BIOSENSOR RESEARCH	2398	1668	0	0	0	0	0	0
97B BLOOD SAFETY	6522	7958	0	0	0	0	0	0
97C CANCER CENTER OF EXCELLENCE	2015	0	0	0	0	0	0	0
97E CENTER FOR PROSTATE DISEASE RESEARCH AT WRAMC	6139	5433	0	0	0	0	0	0
97I DREAMS	7674	10484	0	0	0	0	0	0
97O LUNG CANCER RESEARCH	3358	8578	0	0	0	0	0	0
97S MOLECULAR GENETICS AND MUSCULOSKELETAL RESEARCH	8634	8102	0	0	0	0	0	0
97T NEUROTOXIN EXPOSURE TREATMENT	16308	20253	0	0	0	0	0	0

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BUDGET ACTIVITY 3 - Advanced technology development		PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY								
97V	POLYNITROXILATED HEMOGLOBIN	958	953	0	0	0	0	0	0	0
97W	SEATREAT CANCER TECHNOLOGY	1630	0	0	0	0	0	0	0	0
97X	SYNCHROTRON-BASED SCANNING RESEARCH	8154	0	0	0	0	0	0	0	0
97Y	VIRTUAL RETINAL DISPLAY TECHNOLOGY	1439	1906	0	0	0	0	0	0	0
98A	ARTIFICIAL HIP VOLUMETRICALLY CONTROLLED MFG	3358	0	0	0	0	0	0	0	0
MB1	ADV DIAGNOSTICS & THERAPEUTIC DIG TECH	1246	0	0	0	0	0	0	0	0
MB2	BRAIN, BIOLOGY, AND MACHINE	1726	2859	0	0	0	0	0	0	0
MB3	CENTER FOR INTEGRATION OF MEDICINE & INNOV TECH	8154	6673	0	0	0	0	0	0	0
MB4	CENTER FOR UNTETHERED HEALTHCARE	958	953	0	0	0	0	0	0	0
MB5	CONTINUOUS EXPERT CARE NETWORK TELEMEDICINE	1439	0	0	0	0	0	0	0	0
MB6	FRAGILE X SYNDROME	958	0	0	0	0	0	0	0	0
MB7	HEMOGLOBIN BASED OXYGEN CARRIER	958	4289	0	0	0	0	0	0	0
MB8	HEPATITIS C	3263	0	0	0	0	0	0	0	0
MB9	JOINT US NORWEGIAN TELEMEDICINE	1343	2669	0	0	0	0	0	0	0
MC1	MEMORIAL HERMANN TELEMED NETWORK	958	0	0	0	0	0	0	0	0
MC2	MONOCLONAL ANTIBODIES, MASS BIO LAB	958	0	0	0	0	0	0	0	0
MC3	SACCADIC FATIGUE MEASUREMENT	958	953	0	0	0	0	0	0	0
MC4	SECURE TELEMEDICINE TECH PROGRAM	1919	1715	0	0	0	0	0	0	0
MC5	SPINE RESEARCH AT WRAMC	2015	0	0	0	0	0	0	0	0
MC6	TRAUMA RESEARCH CENTER	2015	0	0	0	0	0	0	0	0
MC7	NATIONAL TISSUE ENGINEERING CENTER	1919	0	0	0	0	0	0	0	0
MC9	MEDICAL SIMULATION TRAINING INITIATIVE	719	953	0	0	0	0	0	0	0
MD1	EMERGENCY TELEMED RESPONSE & ADV TECH	1439	1906	0	0	0	0	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development		PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY							
MD2	VETERANS COLLABORATIVE CARE MODEL PROGRAM	1630	0	0	0	0	0	0	0
ME1	CHILDREN'S HOSPICE PROGRAM	0	1431	0	0	0	0	0	0
ME2	CLINICAL INFORMATION SYSTEMS INITIATIVE	0	1142	0	0	0	0	0	0
ME3	INSTITUTE FOR RESEARCH AND EDUCATION	0	4001	0	0	0	0	0	0
ME4	LASER FUSION ELASTIN	0	4050	0	0	0	0	0	0
ME5	MEDICAL VANGUARD FOR DIABETES MANAGEMENT	0	2382	0	0	0	0	0	0
ME6	MOBILE INTEGRATED DIAGNOSTIC/DATA ANALYSIS SYSTEM	0	953	0	0	0	0	0	0
ME7	RURAL TELEMEDICINE DEMONSTRATION PROJECT	0	953	0	0	0	0	0	0
ME8	STABLE HEMOSTAT	0	1668	0	0	0	0	0	0
ME9	BEHAVIORAL/COMPARATIVE GENOMICS	0	2907	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element supports focused research for healthy, medically protected soldiers, and funds research consistent with the "Medical" and "Survivability" technology areas of the Objective Force. The primary goal of this program is to provide, with minimum adverse effects, maximum soldier survivability and sustainability on the integrated battlefield as well as in military operations other than war. This program element funds advanced technology development for the Department of Defense (DoD) core Vaccine and Drug Program, field medical protective devices, and combat injury management. The DoD core Vaccine and Drug Program provides, in accordance with Food and Drug Administration (FDA) regulations, drugs and vaccines for development that are effective protectants, treatments, and antidotes against military disease threats. Pilot and standard lots of candidate pharmaceutical-grade drugs, antidotes, and vaccines are produced. Funds new technologies and demonstrations in combat casualty care to reduce battlefield deaths and stabilize casualties for delayed evacuation in austere medical environments. Funds studies and demonstrations of biomedical products designed to protect, sustain, and enhance soldier performance under various environmental and physiological stressors and materiel hazards. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. The U.S. Army Medical Research and Materiel Command manage this program element. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603002A - MEDICAL ADVANCED TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	174042	16590	19925	21583
Current Budget (FY 2004/2005 PB)	169598	166406	35168	38686
Total Adjustments	-4444	149816	15243	17103
Congressional program reductions				
Congressional rescissions		-2991		
Congressional increases		158450		
Reprogrammings	270	-951		
SBIR/STTR Transfer	-4714	-4692		
Adjustments to Budget Years			15243	17103

Program Change Summary Explanation: Funding - FY 2004/2005: Funds increased to support acceleration of medical mission package efforts to meet Objective Force timeliness. Funds realigned from PE 0602787A.

Change Summary Explanation: Funding: FY 2003 - Program responsibility for management and oversight of HIV R&D efforts was transferred to the National Institutes of Health (NIH). FY2004 – Program transferred back to the Army.

FY03 Congressional adds:

Project

804	Prostate Cancer Research - Gallo Center	\$1,050
814	Neurofibromatosis Research Program (NF)	\$20,000
818	National Functional Genomics Project	\$5,000
840	Life Support for Trauma and Transport (LSTAT)	\$1,750
929	Intravenous Membrane Oxygenator	\$1,000
941	Joint Diabetes Project	\$4,250
941	Joslin Diabetes Project	\$4,250
941	Juvenile Diabetes Research	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603002A - MEDICAL ADVANCED TECHNOLOGY

\$2,550

969	Neurology Gallo Center-Alcoholism Research	\$3,500	
973	Bioprocessing Initiative	\$2,000	
97A	Technologies for Metabolic Monitoring	\$1,750	
97B	Blood Safety	\$8,350	
97E	Center for Prostate Disease Research at WRAMC	\$5,700	
97I	Texas Training and Technology for Trauma and Terrorism (Dreams)	\$11,000	
97O	Biology, Education, Screening, Chemoprevention and Treatment (BESCT) Lung Cancer Research Program (MDACC)		\$9,000
97S	Molecular Genetics and Musculoskeletal Research Program	\$8,500	
97T	Neurotoxin Exposure Treatment Research Program (NETRP) Parkinson's		\$21,250
97V	Polynitroxylated Hemoglobin	\$1,000	
97Y	Retinal Scanning Display Technology	\$2,000	
MB2	Brain Biology and Machine Initiative	\$3,000	
MB3	Center for Integration of Medicine and Innovative Technology (CIMIT)		\$7,000
MB4	Center for Untethered Healthcare	\$1,000	
MB7	Hemoglobin Based Oxygen Carrier	\$4,500	
MB9	Joint U.S. - Norwegian Telemedicine	\$2,800	
MC3	Saccadic Fatigue Measurement	\$1,000	
MC4	Medvizer Secure Telemedicine Program	\$1,800	
MC9	Medical Simulation Training Initiative (MSTI)	\$1,000	
MD1	National Bioterrorism Civilian Medical Response Center (CIMERC)		\$2,000
ME1	Children's Hospice Program	\$1,500	
ME2	Clinical Information Systems Initiative	\$1,200	
ME3	Institute for Research and Education	\$4,200	
ME4	Laser Fusion Elastin	\$4,250	
ME5	Medical Vanguard for Diabetes Management	\$2,500	
ME6	Mobile Integrated Diagnostic and Data Analysis System (MIDDAS)		\$1,000
ME7	Rural Telemedicine Demonstration Project	\$1,000	
ME8	Stable Hemostat	\$1,750	
ME9	Comparative Functional Genomics Initiative	\$1,500	
ME9	National Center for Behavioral Genomics	\$1,550	

FY03 Congressional Add projects with no R-2As not listed/defined due to space limitations.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY					PROJECT 800			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
800 TELEMEDICINE TESTBED	1596	1895	1985	2054	3908	4384	4490	4591	

A. Mission Description and Budget Item Justification: This project supports the "Medical" technology area of the Objective 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. It funds development, evaluation, and demonstration of prototype advanced technology concepts and materiel for provision of enhanced Force Health Protection. This program supports the Objective Force transition path of the Transformation Campaign Plan. There are no Defense Emergency Response Funds provided to this project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, completed the third and final major program demonstration of the Joint Medical Operations-Telemedicine Advanced Concept Technology Demonstration and fielded an equipment set providing telemedicine capability consisting of computers, data-capable radios, and satellite communications phones. Enabled medical command and control, telemedicine capability, and medical modeling and simulation to further refine operational and materiel concepts, in support of the Pacific Command operational mission. FY03, complete an assessment of operational utility and develop a detailed program report for the Office of the Secretary for Defense Advanced Systems and Concepts, USAMRMC, and the Combatant Commander sponsor. Transition products and operational concepts with identified utility and value to applicable programs of record or appropriate combat developers.	1596	1895	0	0
FY04, conduct field-tests to assess capabilities of remote neuropsychiatric evaluation technologies of soldiers suffering from stress syndromes. FY05, demonstrate high reliability technologies for remote diagnoses and prospect for recovery from specific classes of neuropsychiatric cases such as chronic multisymptom illnesses and impending stress casualties. Test capability to remotely identify and triage impending stress casualties across the battlefield to reduce potential medical evacuations due to combat stress.	0	0	1985	2054
Totals	1596	1895	1985	2054

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY					PROJECT 810			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
810 IND BASE ID VACC&DRUG	8410	8772	18156	19955	20301	21799	22312	22836	

A. Mission Description and Budget Item Justification: This project matures and demonstrates medical countermeasures to naturally occurring infectious diseases potentially affecting the Objective Force. Infectious diseases pose a significant threat to operational effectiveness and 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, the bacterial diseases responsible for diarrhea (i.e., caused by Shigella, enterotoxigenic Escherichia coli, and Campylobacter), and viral diseases (i.e., dengue fever and hantaviruses). The program also develops improved materiel for control of insect/arthropod disease vectors and addresses a variety of other threats to mobilizing forces, including meningitis, viral encephalitis, and hemorrhagic fevers. Improved diagnostic capabilities are also pursued that enable rapid battlefield identification and management of diseases and allow informed medical and tactical decisions. Goals include preclinical and clinical testing of protein and DNA vaccines; testing of new technologies to enhance effectiveness and duration of vaccines; compounding and testing multicomponent vaccines that can protect against multiple disease strains; and producing vaccines and antimalarial drugs under Food and Drug Administration (FDA) regulated current Good Manufacturing Practices and demonstrate their safety and efficacy. Intramural research under this project is conducted at the US Army Medical Research and Materiel Command's Walter Reed Army Institute of Research and its overseas laboratories, and the Naval Medical Research Center and its overseas laboratories and the Medical Research Institute of Infectious Diseases. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY	PROJECT 810
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, demonstrated in human trials limited-term protection against falciparum malaria with the RTS,S vaccine. Demonstrated safety and immune response in animals of candidate falciparum malaria vaccines and found the falciparum AMA-1 vaccine suitable for human trials. FY03, complete clinical testing of DNA-based malaria vaccines. Increase effectiveness of the RTS,S vaccine by combining with other falciparum protein and DNA vaccines together with other components to enhance effectiveness of the vaccine. Continue development of additional vivax candidate vaccines. FY04, conduct FDA Phase 1 and Phase 2 trials of several candidate malaria vaccines. FY05, test and select malaria blood stage vaccine components for integration into lead malaria vaccine candidate; continue clinical testing of malaria vaccine components.	2046	1384	3637	4195
FY02, performed preclinical studies of two Shigella vaccine candidates that support continued development. Conducted animal safety studies of candidate enterotoxigenic E. coli (ETEC) and Campylobacter vaccines. FY03, continue Phase 1/2 clinical testing of Shigella vaccines. Complete safety and effectiveness testing of a candidate vaccine against ETEC diarrhea and move toward clinical trials. Complete FDA Phase 1 clinical testing of a protein Campylobacter vaccine. FY04, complete FDA Phase 2 clinical testing of ETEC and Shigella vaccines. Conduct Phase 1/2 clinical studies of Campylobacter vaccines. FY05, test prototype hybrid multiagent, antidiarrheal vaccines; test subcomponents vaccine candidate in Phase 1 trials.	1990	1805	4025	4388
FY02, prepared for animal trials of candidate dengue DNA vaccines and initiated application for clinical trials of weakened live dengue virus vaccines; completed initial preclinical studies of group B meningitis vaccine candidates; and completed manufacturing of Hemorrhagic Fever with Renal Syndrome (HFRS) DNA vaccine. FY03, complete FDA Phase 1 clinical trials of dengue DNA and HFRS vaccines. FY04, conduct Phase 2 clinical trial of dengue and HFRS vaccines and conduct initial clinical studies of a group B Meningococcal vaccine. FY05, begin preclinical testing of new molecularly modified dengue virus vaccine candidate, continue Phase 2 testing of HFRS vaccine, and initiate IND for new group B meningococcal vaccine.	2513	2754	6470	7035

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY	PROJECT 810			
<u>Accomplishments/Planned Program (continued)</u> FY02, conducted preclinical testing of leading intravenous candidate drugs to treat severe and complicated malaria and selected the Artesunate compound for continued development. FY03, complete preclinical testing of Artesunate antimalarial drug candidate. Conduct initial preclinical testing in animals of several candidate drugs that prevent malaria and select best for initial clinical testing. File an investigational new drug application with the FDA for Artesunate and conduct clinical trials. FY04, move candidate drugs to prevent malaria into Phase 1 trials and down-select best candidate for Phase 2 testing. FY05, complete Phase 2 testing of Artesunate for treatment of severe malaria and transition to advanced development. Continue to test drugs to prevent malaria in preclinical trials and select drugs to take to clinical trials.	<u>FY 2002</u> 1861	<u>FY 2003</u> 2829	<u>FY 2004</u> 4024	<u>FY 2005</u> 4337	
Totals	8410	8772	18156	19955	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY					PROJECT 819			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
819 FLD MED PROT/HUM PERF	534	545	1450	1614	1654	1683	1724	1763	

A. Mission Description and Budget Item Justification: This project supports 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. Specific support includes medical development of tools for assessing weapon system user health risks, diagnostic tools, and treatments to rapidly diagnose and treat laser eye injuries on the battlefield, injury prediction tools for assessing soldier survivability and designing effective individual protective equipment, drugs to sustain soldier performance during continuous operations, and tools for assessing health risks to soldiers in operational environments. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY	PROJECT 819
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
FY02, developed and tested concept demonstration biomonitoring systems to detect chemical contaminants in water and adopted a prototype test kit to identify chemical and microbial contaminants in field drinking water supplies. FY03, develop a refined concept demonstration biomonitoring system for detecting chemical contaminants in water for independent evaluation and establish a prototype reproductive toxicity test using preliminary results. FY04, develop a prototype portable aquatic biomonitor for monitoring chemical contamination in water in the field to identify potential health risks to soldiers and progress from laboratory to a prototype field test kit for rapid detection of chemical and microbial contaminants in food and drinking water and perform field testing. Establish prototype health risk assessment software and prepare final user documentation for a method to assess health risks for soldiers exposed to repeated jolts in ground vehicles and helicopters. FY05, conduct testing of a protective drug to decrease or eliminate laser retinal injury in soldiers, and develop prototype software and final user documentation for an inhalation injury prediction tool (Toxic Gas Analysis Software) to assist in the development of operator-safe weapon systems and operational doctrine that minimizes the potential for inhalation injury.	534	545	1450	1614
Totals	534	545	1450	1614

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY					PROJECT 840			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
840 COMBAT INJURY MGMT	4949	5846	13577	15063	21505	24197	31371	28279	

A. Mission Description and Budget Item Justification: In FY03 through FY07, this project matures and demonstrates new technologies in support of Medical Mission Package (FCS Blk II) with new candidate IV clotting drugs; an assisted critical care support system for far-forward management and transport of casualties; advanced technologies for treating extremity injuries to bone and flesh; freeze-dried plasma that lightens logistical load and provides treatment of hemorrhage; and effective means to enable the combat medic to effectively perform remote triage of battlefield casualties that are widely dispersed on the Objective Force battlefield and to thereby maximize field medic resources. In FY03 through FY09, this project matures and demonstrates a handheld device, the "Warrior Medic," that enables the combat medic to quickly link with and assess a range of casualty vital signs and other markers of injury and that provides casualty management guidelines for the medic; and an agent that enables field medical personnel to quickly and non-surgically control internal bleeding. In FY04 through FY09, this project matures and demonstrates new technologies in support of Medical Mission Package (FCS Blk IV) with 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 critical care system for enhanced management, transport, and survival of stabilized casualties 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. The project funds prototypes of non-system-specific medical materiel items for far-forward medical management of trauma in combat casualties, including preclinical testing of candidate drugs and biologic compounds and devices/equipment to obtain data necessary for Food and Drug Administration (FDA) approval for human use. Focus areas include testing and demonstrations in drugs and devices to enhance the body's clotting function; strategies and products to optimize casualty resuscitation; novel blood products and medical devices to improve survival and reduce the logistics burden; compact dental technologies and systems for enhanced dental care in the combat zone; and neuroprotective drugs to minimize consequences of head injury. Internal research under this project is conducted at the US Army Medical Research and Materiel Command's US Army Institute of Surgical Research, and the Walter Reed Army Institute of Research and its overseas laboratories. Major contractors include Integrated Medical Systems, Signal Hill, California and the American Red Cross. This program supports the Objective Force transition path of the Transformation Campaign Plan.

There are no Defense Emergency Response Funds provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603002A - MEDICAL ADVANCED TECHNOLOGY	PROJECT 840
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Medical Mission Pkg (FCS Blk II): FY02, studied effectiveness of candidate hemorrhage control gels for control of severe internal bleeding without surgery in animals; performed animal studies of candidate intravenous drugs to enhance blood clotting; designed animal models for hemorrhage control studies; completed studies of antimicrobial pins for fracture repair and of antimicrobial bone filler material; conducted preclinical evaluation of a self-contained, 20-pound intensive care life support system to reduce logistics footprint and enhance battlefield casualty care. FY03, study effectiveness of potential hemorrhage control agents (foam, liquid) in controlling severe internal bleeding in animals; conduct animal studies of candidate drugs to enhance blood clotting. FY04, study effectiveness of candidate hemorrhage control agents (gel, foam, liquid) in controlling severe internal bleeding, evaluate wound-protectant device and improved tourniquet device in animals and submit investigational device exemption application to the FDA, conduct proof-of-concept studies of a small antimicrobial wound cleaning device, conduct proof-of-concept studies of light-weight materials and splints for fracture stabilization. FY05, demonstrate in animals the effectiveness of a handheld device that stops bleeding with sound waves, study in animals the effectiveness of candidate drugs to enhance blood clotting and drugs to restore blood clotting in the presence of abnormal clotting, conduct Phase I clinical tests of an improved tourniquet; conduct tests to select the best wound cleaning device; conduct animal tests of lightweight materials and splints.	3034	3692	8754	8953
Warrior Medic: FY02, completed clinical evaluation of range finding micro-impulse radar (MIR) for heart rate and respiratory rate measurement. FY03, conduct trials of MIR vital signs monitor to determine its resistance to external movement. FY04, format MIR into a wearable prototype for continuous soldier monitoring through clothing. FY05, transition handheld MIR vital signs monitor to advanced development.	199	189	711	1693
Medical Mission Pkg (FCS Blk IV): FY02, completed technical testing of a personal oxygen generation system to replace oxygen cylinders on the battlefield. FY03, conduct animal studies of commercially available candidate resuscitation fluids for best efficacy. FY04, conduct clinical studies to select the best commercially available resuscitation fluid(s). FY05, conduct studies in animals of a handheld device that stops bleeding with acoustic energy for use at the battalion aid station.	1318	1547	3418	3588

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603002A - MEDICAL ADVANCED TECHNOLOGY

PROJECT

840

Accomplishments/Planned Program (continued)

FY02, completed preclinical studies necessary for transition of dental field treatment and operating system to the Army Medical Department Center and School Testing and Evaluation Board for eventual fielding and deployment; conducted studies of methods to inactivate infectious agents in whole blood to enhance blood safety; tested a new penetrating head injury (PHI) model on rodents. FY03, determine toxicity of the anti-cavity and anti-plaque additive for meals ready to eat (MREs); conduct studies to inactivate infectious agents in both whole blood and red blood cells; conduct preclinical studies of candidate freeze dried plasma lots. FY04, complete development of a new PHI model, conduct studies of candidate packaging systems for freeze-dried blood products that will enhance delivery and storage of blood products in the field, initiate development of formulation and application methodology of an anti-cavity/anti-plaque food additive to prevent dental disease. FY05, conduct clinical studies of freeze-dried plasma; complete development of formulation and application methodology of an anti-cavity/anti-plaque food additive to prevent dental disease; conduct neuroprotection drug studies in the PHI model to identify a drug to improve survival and residual brain function in casualties with brain injury.

FY 2002

FY 2003

FY 2004

FY 2005

398

418

694

829

Totals

4949

5846

13577

15063

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	37290	41924	72083	70327	91734	108354	119501	122798
313 ADV ROTARYWING VEH TECH	16533	22161	60340	53147	77641	93724	89810	85679
435 AIRCRAFT WEAPONS	1473	2191	977	4116	4121	3334	4137	5091
436 ROTARYWING MEP INTEG	9291	7045	3849	5859	1945	2894	16960	23232
447 ACFT DEMO ENGINES	9993	6477	6917	7205	8027	8402	8594	8796
B97 A/C AVIONICS EQUIPMENT	0	4050	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 in support of the Objective Force and Joint Vision 2020. Based on the Army transformation, this PE is focused to demonstrate technologies applicable to unmanned systems, manned/unmanned teaming, and selected opportunities for manned systems. Unmanned rotary wing vehicles bring unprecedented agility, maneuverability, and lethality to the Objective Force while providing reduced signature and logistics. Within this PE, aviation technologies will be matured and integrated into realistic and robust demonstrations. Emphasis will be placed on maturing unmanned attack, reconnaissance, and lift capabilities and teaming them with Objective Force manned systems. Technologies that enable increased 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. This PE provides technical support and technology transition to Unmanned Aerial Vehicles (UAVs), to include the A-160 Hummingbird, the Unmanned Combat Armed Rotorcraft (UCAR), the Organic Air Vehicle (OAV), and the Micro Air Vehicle (MAV). This PE also supports the RAH-66 Comanche, and other Objective Force aviation systems. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance for which the Army is the lead service for the maturation of rotorcraft science and technology. Related applied research is conducted under PE 0602211A (Aviation 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). The program element contains no duplication with any effort within the Military Departments. The Aviation and Missile Research, Development and Engineering Center, Redstone Arsenal, AL performs work in this PE. This PE supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603003A - AVIATION ADVANCED TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	38496	45404	74754	83300
Current Budget (FY 2004/2005 PB)	37290	41924	72083	70327
Total Adjustments	-1206	-3480	-2671	-12973
Congressional program reductions		-6908		
Congressional rescissions		-1073		
Congressional increases		5850		
Reprogrammings	-198	-240		
SBIR/STTR Transfer	-1008	-1109		
Adjustments to Budget Years			-2671	-12973

Change Summary Explanation:

Significant Changes:

Funding - FY 2004: Funds added to this PE to conduct flight demonstrations of technologies necessary for the vertical maneuver of the Objective Force.

Funding - FY 2004/2005: Funds realigned from this PE to PE 0602211A Aviation Technology to conduct applied research for increasing levels of autonomy for vertical takeoff and landing (VTOL) unmanned aerial vehicles (UAV).

FY03 Congressional Adds:

Unmanned Aerial Vehicle Data Links – Airborne Manned Unmanned System Technology (AMUST) , Project 436 (\$1600); Radar Surveillance and Assimilation Network, Project B97 (\$4250).

Project with no R-2A:

(\$4073), Radar Surveillance and Assimilation Network, Project B97. The objective of this one-year Congressional Add is to develop a detailed design for an advanced open systems mission avionics architecture for an advanced Army rotorcraft. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY					PROJECT 313			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
313 ADV ROTARYWING VEH TECH	16533	22161	60340	53147	77641	93724	89810	85679	

A. Mission Description and Budget Item Justification: The Advanced Rotary Wing Vehicle (RWV) Technology project matures and demonstrates rotary wing unmanned and manned platform technologies for the Objective Force. It is envisioned that the Objective Force will need unmanned and manned rotorcraft systems that have significantly increased/improved lift, range, survivability, and mission capability with an overall reduction in logistics and cost of operation. Key to this effort is the demonstration of vertical takeoff and landing (VTOL) UAVs for the Objective Force. The critical technologies to support these capabilities will be matured through Technology Demonstrations (TDs) of prototype UAVs, rotors, active controls, structures, drive train, integrated architecture and threat protection. The near term demonstration of unmanned, VTOL UAVs will focus on the A-160 Hummingbird UAV and the Organic Air Vehicle (OAV), to include the Micro Air Vehicle variant, for Reconnaissance, Surveillance and Target Acquisition (RSTA) capability. The farther term demonstrations will focus on the Unmanned Combat Armed Rotorcraft (UCAR) teamed with manned and unmanned airframes, the RAH-66 Comanche and the A-160 Hummingbird. UCAR is a joint program with the Defense Advanced Research Projects Agency (DARPA) cost shared 50% - 50%, and is planned to transition to Program Executive Officer Aviation at the completion of its 6.3 funded phases. These demonstrations will focus on military operations and the application of military specification on these maturing systems. The integration of technology into UAV manned teaming operations will be demonstrated through the merging common operating architecture and team survivability. The Survivable, Affordable, Repairable Airframe Program (SARAP) will reduce weight and increase the survivability for manned and unmanned systems. The Rotorcraft Drive Systems for the 21st Century (RDS21) TD will provide a 35% increase in power-to-weight ratio, 20% reduction in both production and operating and support 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 Objective Force capability and will enable a 40% increase in payload for the AH-64 Apache, a 33% increase in payload for the RAH-66 Comanche, a 20% increase in range for the UH-60 Black Hawk, and over a 25% increase in range for the CH-47 Chinook. The 20% reduction in production cost and operating and support costs would result in savings of \$153M and \$117M respectively for a 300 A/C fleet of advanced cargo rotorcraft. The Helicopter Active Control Technology (HACT) TD will contribute to a 50-100% increase in payload, 100-200% increase in range and 50-65% improvement in maneuverability / agility when integrated with the RWV system. Work in this project is performed by contractors including: Boeing Company, Mesa, AZ, St. Louis, MO and Philadelphia, PA; Bell Helicopter Textron Incorporated, Ft. Worth, TX; Lockheed Martin, Atlanta, GA; Sikorsky Aircraft Corporation, Stratford, CT; Raytheon Company, Arlington, VA; and United Technologies Research Center, Hartford, CT. This system supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY	PROJECT 313
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Integrated UAV Operations – In FY02, developed intelligent agent architecture to permit cooperative/collaborative exchange of survivability data between tactical vehicles. Analyzed current and future manned and unmanned rotorcraft mission avionics requirements and updated the Rotorcraft Technical Architecture. In FY03, integrate architecture on Lot 7 AH-64D Longbow Apache and Army Airborne Command and Control System (A2C2S) UH-60 Black Hawk. Conduct test on hot bench to ensure proper function on operational processors and with aircraft communications system. Design embedded mission avionics architecture for use on manned and unmanned rotorcraft based on market driven commercial-off-the-shelf electronics and well supported open systems specifications and standards. In FY04, complete architecture detailed designs and system integration tests, and initiate flight-test of the manned-unmanned architecture on both the AH-64D Longbow Apache and A2C2S UH-60 Black Hawk, individually and jointly. Conduct system level demonstration of common architecture between manned and unmanned rotorcraft. Conduct data analysis of demonstration results. FY05, complete flight tests and data analysis, publish systems architectures, and coordinate updates to the Joint Technical Architecture-Army as appropriate.	4221	8482	10896	2000
A-160 Hummingbird - In FY03, conduct initial A-160 functional/environmental ground-test of Phase I subsystems. Perform continuous flight tests with first two (Phase 0) A-160s. In FY04, conduct system flight-testing to test-fix-test of airframe and components at gross weights up to 4,000 pounds and altitudes up to 20,000 feet. Continue environmental testing in ice, sand and salt. Review A-160 flight test results, including initial mission equipment package (MEP) integration with electro-optic/infra-red (EO/IR) sub-systems. Conduct functional and environmental ground-test results for Phase I subsystems and Ground Control Station. Validate baseline Phase I configuration and capabilities. In FY05, conduct continuous air vehicle system flight tests at gross weights up to 5,000 pounds, altitudes up to 30,000 feet, and rotor speed up to 100%. Continues refinement of the Ground Control Station, airframe and mission equipment package, to include EO/IR flight demonstration with four A-160s (two Phase 0 and two Phase I). Validate revised Phase I configuration and capabilities.	0	5000	10000	15000

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603003A - AVIATION ADVANCED TECHNOLOGY

313

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
<p>Unmanned Combat Armed Rotorcraft (UCAR) - The UCAR program goal is to demonstrate an armed VTOL UAV that is survivable; can identify targets at 6-10 km and can recognize dismounted infantry at 2-6 km; has a flyaway cost that is 20%-40% of Comanche; and has an operating and sustainment cost that is 20%-50% of Apache. Applied Research for UCAR was conducted in FY02 and FY03 in PE 0602211A Aviation Technology. In FY04, complete UCAR Phase II, Preliminary Design. Industry teams will identify best technical approach considering mission effectiveness, lethality, system performance, and autonomous operations/command & control. In FY04, begin UCAR Phase III, Development and Test. Industry teams conduct detail design of best technical approach, and execute critical design review. Conduct bench testing of critical systems/subsystems as identified in the Risk Management and Mitigation Plan. Define design characteristics/attributes as required to satisfy system performance requirements. In FY05, industry teams conduct bench testing and design support testing of critical UCAR system components. Fabricate two full-scale system demonstrators. Develop an air or ground based control console. Conduct UCAR ground and initial tie-down and light testing to demonstrate and characterize system performance.</p>	0	0	14000	20000
<p>Drive Train - Rotorcraft Drive System for the 21st Century (RDS21). In FY02, conducted detailed design/analysis of RDS-21 key technologies (face gears, high speed clutch, composite housings). In FY03, conduct rig testing to establish Face Gear design and durability of high speed clutch. In FY04, fabricate full-scale test hardware and full-scale RDS-21 split torque/face gear demonstration hardware and composite housing. In FY05, conduct goal demonstration testing (weight/durability/noise) of RDS-21 demonstrator.</p>	3361	4886	4955	5942
<p>Rotorcraft Controls - Helicopter Active Control Technology (HACT). In FY02, flew advanced flight controls to demonstrate improved rotorcraft control, handling qualities and mission effectiveness. Flight demonstrated the program goals of 65% improve pointing accuracy, 35% reduction flight test development time, and 40% increase in precision hover.</p>	7000	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603003A - AVIATION ADVANCED TECHNOLOGY

313

Accomplishments/Planned Program (continued)

Rotorcraft Structures - Survivable, Affordable Repairable Airframe Program (SARAP). In FY02, identified composite structures technologies for maturation and demonstration to improve rotary-wing airframe weight, cost, supportability, and survivability. In FY03, incorporate composite structures technologies into manned / unmanned prototype designs to improve rotary-wing airframe weight, cost, supportability, and survivability. Enhance non-developmental items (NDI) and repair methods for advanced composite structures. Mature low-cost, lightweight structural concepts and draft damage tolerance certification methodology for fatigue critical composite components. In FY04, conduct major effort of the SARAP program with manned / unmanned rotary-wing virtual prototype (VP) models and simulations that improve airframe weight 25% and cost 40%. Validate damage tolerance methodology through hardware test for 5% weight reduction in fatigue sensitive composite components. Fabricate VP validation hardware for live fire, static, and crash testing. In FY05, validate manned / unmanned virtual prototype models and simulations with full-scale hardware fabrication and test to improve weight, cost, supportability, and survivability. Conduct full-scale hardware live fire, static, fatigue, and crash testing to validate virtual prototype models and simulations. Transition composite structural technologies, concepts, and methodologies to developmental manned and unmanned RW systems such as A-160 and UCAR.

FY 2002	FY 2003	FY 2004	FY 2005
1951	3793	9960	4083

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603003A - AVIATION ADVANCED TECHNOLOGY

PROJECT

313

	FY 2002	FY 2003	FY 2004	FY 2005
<u>Accomplishments/Planned Program (continued)</u>				
Next Generation Organic Air Vehicle (OAV) - Vehicle mounted and manpack [Micro Air Vehicle (MAV)] Lift Augmented Ducted Fan UAVs for reconnaissance, surveillance, target acquisition. In FY04, expand OAV operational and performance envelopes through tests, experiments, and operational demos utilizing military operators supported by developers and testers. Perform testing to determine OAV acoustic signature and associated detectability. Incorporate and demonstrate noise reduction features, primarily in the propulsion and lift/drive areas, determine reductions in signature and vulnerability. Develop and demonstrate the OAV Autonomous Control Level (ACL) to a level of 3-4 (Fault/Event Adaptive Vehicle), supports growth to an objective ACL of 9-10, (fully autonomous) through the process of spiral development, supports the DoD/DARPA Intelligent Autonomy initiative. Develop models, perform constructive and virtual simulations to support concept development, operational effectiveness testing, lethality and survivability determination. Characterize and assess flight control impact of manned system flow fields for OAV launch and recovery. In FY05, incorporate any necessary "fixes" and system improvements, e.g., heavy fuel propulsion, acoustics, and mission equipment (sensors, processors, and architectures). Develop/advance OAV autonomy levels and teaming capability, and participate in combined DoD Intelligent Autonomy demonstration. Demonstrate capability to acquire and identify targets, ability to engage same with lethal mechanism identified in concept development effort. Conduct demonstration of automatic obstacle avoidance capability. Identify and evaluate alternate OAV launch and recovery concepts and perform design and fabrication.	0	0	4068	6122
Heavy Lift Demonstration for Objective Force Air Maneuver. In FY04, conduct demonstration to characterize the technology attributes necessary for a vertical takeoff with a 40,000 pound (20 ton) cargo load in a single, commercially available, helicopter at sea level conditions.	0	0	4615	0
Slowed Rotor Demonstration. In FY04, demonstrate the principle of a slowed main rotor which is optimized for minimum drag, utilizing a vertical takeoff and landing gyro-copter.	0	0	1846	0
Totals	16533	22161	60340	53147

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY						PROJECT 435	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
435 AIRCRAFT WEAPONS	1473	2191	977	4116	4121	3334	4137	5091

A. Mission Description and Budget Item Justification: The Aircraft Weapons project matures manned and unmanned rotorcraft sensor and weaponization technologies for air-to-air and air-to-ground application. This project supports the Objective 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. Integration of advanced missiles, rockets, guns, fire control, advanced target acquisition and pilotage sensors, and directed energy weapons, including non-lethal capabilities, are evaluated to assure compatibility and demonstrate timely, precision engagement capabilities and the full spectrum effectiveness of the manned/unmanned team. Technology integration issues with on-board systems, vehicle flight characteristics and weapon system are matured and demonstrated. The project will mature Low Cost Precision Kill (LCPK) rocket system using a 2.75-inch rocket with a laser seeker sensor and the project will evaluate other technologies for providing rotorcraft combat enhancements. Work in this project is performed by contractors including: Boeing Company, Mesa, AZ and Philadelphia, PA; Lockheed Martin, Orlando, FL and Atlanta, GA; Northrop Grumman, Baltimore, MD and Raytheon Company, Dallas, TX and Arlington, VA. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Weapons Integration. Includes Low Cost Precision Kill (LCPK), a laser guided 70MM (2.75 inch) folding fin aerial rocket, and Loitering Electronic Warfare Killer (LEWK). In FY02, conducted LCPK Advanced Technology Demonstration AH-64D aircraft integration. In FY03, perform airborne evaluation of the LCPK guided rocket. Conduct AH-64D airborne evaluation of the LCPK guided rocket. Provide technical support to LEWK ACTD. In FY04, provide support to LEWK ACTD. In FY05, investigate precision location of threat radar systems from UAVs. Will conduct initial prototype design of integrated, autonomous engagement systems. Will investigate unmanned teaming and cueing for collaborative engagements.	1473	2191	977	4116
Totals	1473	2191	977	4116

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY	PROJECT 436						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
436 ROTARYWING MEP INTEG	9291	7045	3849	5859	1945	2894	16960	23232

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. This project improves the overall mission execution by demonstrating Manned/Unmanned System teaming, enhanced helicopter pilotage capability and improved crew workload distribution. This project supports the Objective Force and Joint Vision 2020 by providing mature technology to enhance near-real time situational awareness for unmanned and manned rotary wing vehicles. The Airborne Manned/Unmanned System Technology (AMUST) program 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 supports the Hunter Standoff Killer Team (HSKT) Advanced Concepts Technology Demonstration (ACTD). 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 will be matured to maximize 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. Work in this project is performed by contractors including: Boeing Company, Mesa, AZ and Philadelphia, PA, Lockheed Martin, Atlanta, GA, Raytheon Company, Arlington, VA, L3 Communications, Salt Lake City, UT, TRW Systems and Information, San Diego, CA, PhotoTelesis Corporation, San Antonio, TX, Northrop Grumman Information Technology, San Diego, CA, and Integrated Defense Technologies, Buffalo, NY. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY	PROJECT 436
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Airborne Manned and Unmanned System Technology (AMUST), UAV Network Teaming and Hunter Standoff Killer Team (HSKT) Advanced Concepts Technology Demonstration (ACTD). In FY02, integrated UAV control techniques with decision aiding capability to enable effective manned/unmanned teaming. Developed Warfighter's Aid and Mobile Commander's Aid for application to the AH-64D Longbow Apache and the Army Airborne Command and Control System (A2C2S) UH-60 Black Hawk. Expanded AMUST teaming technology to develop a multiple, simultaneous UAV control capability. In FY03, integrate Tactical Common Data Link into manned and unmanned platforms to enable common control. Flight test AMUST teaming technology on AH-64D Longbow Apache, A2C2S UH-60 Black Hawk and Hunter UAV as part of HSKT ACTD. Develop interface control documents to integrate HSKT hardware in a System of Systems construct for AH-64 Apache, Hunter UAV, A2C2S UH-60 Black Hawk and F/A-18. Mature, with user, tactics, techniques, and procedures (TTPs) and training concepts for HSKT System of Systems. Test and evaluate wideband radio frequency network as possible airspace management aid. Will enable technology transition to Objective Force systems. In FY04, develop an Integrated Operational Picture system architecture for actively tasking sensor platforms and systems to build and maintain an Integrated Operational Picture that supports targeting and situation awareness among commanders and warfighters. In FY05, conduct, in simulation, the architecture and algorithms to build an Integrated Operational Picture. Develop TTPs in simulation to formulate a sensor-to-shooter solution for time-critical targets at desired sensor resolution.	9291	5445	3849	5859
UAV Data Link. The objective of this one-year Congressional Add is to develop a Wideband Wireless Network to support AMUST. No additional funding is required to complete this project.	0	1600	0	0
Totals	9291	7045	3849	5859

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY					PROJECT 447			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
447 ACFT DEMO ENGINES	9993	6477	6917	7205	8027	8402	8594	8796	

A. Mission Description and Budget Item Justification: The Aircraft Demonstration Engines project matures power system technologies through competitively performed design, fabrication and test of advanced material technologies, engines and integrated components. This project supports the Objective 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 Joint Turbine Advanced Gas Generator (JTAGG) efforts are all fully coordinated / aligned with the phases / goals of the DoD Integrated High Performance Turbine Engine Technology (IHPTET) program and industry. IHPTET / JTAGG 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. This provides significantly increased range and payload capabilities for future unmanned and manned rotorcraft and sustainment upgrades for current engines, with significant Operation and Support cost savings. The Small UAV Turbo Shaft Engine effort is focusing on providing affordable, efficient heavy fuel capability to unmanned vehicles requiring horsepower ranging from 70 to 150. The Heavy Fuel Engine program is focusing on developing and demonstrating advanced, affordable turbine engine technology in the 500 horsepower class. Significant improvements in specific fuel consumption and power-to-weight ratio will provide a heavy fuel engine capability for applications such as the A-160 and Future Combat System (FCS). A 50% endurance increase and 30% payload increase relative to current available turbine engines is possible for UAV applications such as A-160. Transition of IHPTET / JTAGG technology also results in significant increase in payload / range capability for the CH-47 Chinook and RAH-66 Comanche helicopters. Typical payoffs are a 33% increase in payload and a 50% reduction in fuel consumption for a CH-47 Chinook cargo mission and a 33% payload improvement and 28% range increase for a RAH-66 Comanche mission. Work in this PE is performed by contractors including: General Electric Aircraft Engines, Lynn, MA; Honeywell Engines and Systems, Phoenix, AZ; Rolls-Royce/Allison Advanced Development Company, Indianapolis, IN; Pratt & Whitney, Hartford, CT; Williams International, Walled Lake, MI; Teledyne Continental Motors, Toledo, OH; and Locust USA, Miami, FL. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603003A - AVIATION ADVANCED TECHNOLOGY	PROJECT 447
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Joint Turbine Advanced Gas Generator (JTAGG) - In FY02, completed testing of the final core engine build in support of the JTAGG II goals of 80% increase in shaft horsepower to weight ratio, 30% decrease in Specific Fuel Consumption (SFC) and 20% reduction in production and maintenance costs. Fabricated and tested components in support of JTAGG III gas generator builds. In FY03, conduct testing of JTAGG III initial gas generator build, which includes a forward swept rotor, a split-inducer impeller, a ceramic matrix composite combustor liner and un-cooled ceramic low pressure turbine blades. Conduct testing of JTAGG III second gas generator build, which introduces a ceramic nozzle in the high-pressure turbine. Affirm in testing the JTAGG III goals of 120% increase in shaft horsepower to weight ratio, 40% decrease in SFC, and 35% reduction in production and maintenance costs with the addition of magnetic bearings and component aerodynamic improvements.	6617	6477	200	0
Small UAV Turbo Shaft Engine - In FY02, conducted a demonstrataion of a UAV turboshaft engine.	3376	0	0	0
Heavy Fuel Turbine Engine - In FY04, design a 500 horsepower class engine demonstrator with goals of: -20% SFC, +50% horsepower to weight ratio, and 35% cost reduction. In FY05, design, build and test components of 500 horsepower class heavy fuel turbine engine.	0	0	6717	7205
Totals	9993	6477	6917	7205

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603004A - Weapons and Munitions Advanced Technology							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	34244	63230	47752	72404	75395	62289	69678	77511
232 ADVANCED MUNITIONS DEM	30877	58861	28091	52779	42063	44653	46127	48090
43A ADV WEAPONRY TECH DEMO	3367	4369	0	0	0	0	0	0
L94 ELECTRIC GUN SYS DEMO	0	0	19661	19625	19606	0	0	0
L96 HIGH ENERGY LASER TECHNOLOGY DEMO	0	0	0	0	13726	17636	23551	29421

A. Mission Description and Budget Item Justification: This Program Element (PE) matures and demonstrates affordable, smaller and/or lighter advanced weapons and munitions technologies to increase battlefield lethality and survivability for the Future Combat Systems (FCS) and the Objective Force. Within Project 232 specific efforts include: FCS Multi-Role Armament and Ammunition System (MRAAS) Advanced Technology Development (ATD); Mid Range Munition (MRM); Multi-Purpose Extended Range Munition (MP-ERM); Advanced Light Armament for Combat Vehicles; Responsive Accurate Mission Module (RAMM); and High Energy Laser Technology Demonstrations. The FCS Multi-Role Armament effort utilizes Electrothermal-Chemical (ETC) propulsion and provides single armament module configurations to support both maneuver and fire support missions. The corresponding FCS Multi-Role Ammunition effort, consisting of a three-cartridge suite, provides overwhelming lethality at ranges up to 50 km (based on chassis configuration) with greater precision and accuracy, and with reduced logistics footprint. RAAM demonstrates a semi-autonomous, turreted mortar system. The significant increase in FY03 funding (Project 232) accelerates development of the MRM to meet the need for a beyond line-of-sight munition for FCS. The MP-ERM effort demonstrates an increase in armor penetration and combat overmatch against the full target spectrum by using a cartridge containing advanced explosively formed penetrator (EFP) warheads that exploit energetics, liner materials and modeling/simulation technologies. The Fire Control-Node Engagement Technology (FC-NET) program will develop a common fire control system for FCS gun and missile weapon systems. Advanced Acoustic Seismic Sensors provides networked acoustic/seismic sensors and aeroacoustic propagation models for the Networked Sensors for the Objective Force ATD. Beginning in FY06, FCS Armament Munitions will mature technologies used for affordable sub-munitions, smart mortar munitions and lighter weight launchers for the next generation of armaments and munitions. Beginning in FY04, Project L94 will mature enabling technologies for an electromagnetic armament system which has the potential to revolutionize the future battlefield by its unique performance characteristics, leading to a system demonstration in FY06. Also, in FY06 a new project designed to integrate a solid-state laser device into a high energy laser weapons system will begin. This program adheres to Tri-Service Reliance Agreements on conventional air-surface weaponry, with oversight provided by the Joint Directors of Laboratories. Work in this PE is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology), PE 0602618A (Ballistics Tech), PE 0604802A (Weapons and Munitions - Engineering Development), and PE 0602307A (Advanced Weapons Technology). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey. This system supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603004A - Weapons and Munitions Advanced Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	35381	66514	36959	62123
Current Budget (FY 2004/2005 PB)	34244	63230	47752	72404
Total Adjustments	-1137	-3284	10793	10281
Congressional program reductions		-4500		
Congressional rescissions		-1225		
Congressional increases		4550		
Reprogrammings	-167	-363		
SBIR/STTR Transfer	-970	-1746		
Adjustments to Budget Years			10793	10281

Change Summary Explanation: Funding – FY 2004/2005: Funds increased to mature enabling technologies for an electromagnetic armament system.

FY03 Congressional Adds: Development Mission Integration, Project 43A (\$3500); Blended Metals Technology Small Arms Ammunition, Project 43A (\$1050)

Projects With No R-2A:

(\$3500) Development Mission Integration, Project 43A: The objective 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.

(\$1050) Blended Metals Technology Small Arms Ammunition, Project 43A: The objective of this one year Congressional add is to support government-wide testing of revolutionary small arms ammunition with full spectrum of lethal and penetrating effects. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603004A - Weapons and Munitions Advanced Technology					PROJECT 232			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
232 ADVANCED MUNITIONS DEM	30877	58861	28091	52779	42063	44653	46127	48090	

A. Mission Description and Budget Item Justification: This project matures and demonstrates munitions enhancement for the MRAAS and matures emerging technologies in lightweight structures, smart materials, acoustic/seismic sensors and in-flight update architectures. MRM is a gun launched precision munition capable of defeating high value heavy armor and other targets out to 8km. The objective of this accelerated FY02-03 effort is to modify existing munition components, including reducing the size of the guidance and control elements, and demonstrate the BLOS capability for FCS block I. The MP-ERM program evaluates warhead designs against various range targets. The Advanced Light Armament for Combat Vehicles (ALACV) program will develop air bursting munitions and advanced kinetic energy penetrators for medium caliber applications. RAMM will be developed under this project. A Mid-Range Munition (MRM) and the MRAAS Cargo Round provide additional lethality options for FCS. FC-NET will provide a common software package that will recommend weapon-target pairings for missiles and guns and will be expandable to include future weapon types. Advanced Acoustic Seismic Sensors demonstrates networked acoustic/seismic sensors for target tracking and cueing of secondary sensor systems. A Congressionally funded effort to mature and demonstrate Shoulder-Launched Multipurpose Assault Weapon (SMAW) and associated munitions for use in confined spaces will be completed 4QFY02. In-house efforts are accomplished by ARDEC, Picatinny Arsenal, New Jersey and the Army Research Laboratory, Aberdeen Proving Ground, MD. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP). No Defense Emergency Response Funds have been provided to this project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- RAMM: In FY03, fabricate preliminary subsystem hardware of the RAMM mortar module. In FY04, complete RAMM preliminary subsystem integration and testing; conduct RAMM module hardstand test. In FY05, finalize RAMM module software, integrate into a mobile platform and conduct a coordinated demonstration.	0	2800	4300	7200
- ALACV: In FY02, conducted modeling and simulation and laboratory analysis to optimize air bursting warheads and advanced KE penetrators. In FY03, demonstrate integrated medium caliber air bursting projectile lethality of four-fold increase in lethal area over traditional point-detonating warhead against personnel targets. Demonstrate 30% increase in behind armor effects using advanced penetrators.	1760	2100	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603004A - Weapons and Munitions Advanced Technology

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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- MRAAS: In FY02, completed detailed design of lightweight, low impulse multi-role cannon & auto ammo handling system; demonstrated best technical approaches for ETC propellant with increased energy & lower sensitivity; developed design tradeoffs & laboratory demonstrations of fire control software. Conducted airframe and lethality demonstrations of MP-ERM. Developed Smart Cargo projectile preliminary design to include guidance & control; demonstrated best tech approaches for dynamic retargeting to locate & defeat time critical targets; used modeling & simulation to demonstrate maximized payload volume by application of smart materials, structures & metal matrix composites for airframe. In FY03, demonstrate firing of multi-role cannon with integrated cartridge; demonstrate, at subscale, feasibility of achieving 25% increase in energy (retaining current sensitivity) using Gen II ETC propellant; demonstrate fire control software & hardware in a System Integration Laboratory; conduct secondary armament turreted system slew & firing demonstration; conduct testing of auto ammo handling system and load/unload sequence reliability; complete turret design; initiate fabrication of turret structure. Demonstrate defeat of advanced threat armor at extended ranges with integrated novel penetrator & composite sabot; demonstrate critical Guidance & Control & hi-G components for MP-ERM; complete airframe design for Smart Cargo round to achieve deliveries of lethal payloads to 50km. In FY04, conduct BLOS projectile airframe structural integrity demonstration; demonstrate composite sabot with integration of novel penetrator against armor; complete non-line-of-sight projectile design; conduct BLOS projectile warhead demonstration vs armor targets; continue seeker hi-G tests. In FY05, for FCS Multi-role MP-ERM projectile, conduct demonstrations of the system/subsystems of the precision munition including guide to hit demonstration of multimode seeker and warhead.	18221	21357	22041	43829
- Advanced Acoustic Seismic Sensors: In FY04, demonstrate an acoustic/seismic propagation model and networked acoustic/seismic sensors. In FY05, integrate the suite of acoustic/seismic sensors into the Networked Sensors for the Objective Force ATD demonstration.	0	0	1000	1000
- FC-NET: In FY02 develop baseline weapon/missile targeting pairing algorithm. In FY03 Adapt to Fire Control Computer and support feasibility demonstration. In FY04 optimize algorithms and architecture to support TRL5 demonstration. In FY05 provide full functional Enhanced Combat Decision Aid Software with track management configured for demonstration.	500	950	750	750
MRM: FY02, demonstrate in a relevant environment, a representative system/subsystem gun launched guided projectile defeating targets at extended range. In, FY03 demonstrate all remaining subsystems/systems in a relevant environment; fabricate guidance and control hardware and seeker/sensor hardware and conduct hi-g testing; demonstrate prototype MRM projectile in a guide-to-hit test conducted at ambient temperature that shall launch, survive, deploy, sense, maneuver and hit a target at 5km.	8000	31654	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603004A - Weapons and Munitions Advanced Technology	PROJECT 232			
<u>Accomplishments/Planned Program (continued)</u> - The objective of this one year Congressional add for the Shoulder-Launched Multipurpose Assault Weapon (SMAW) and Munitions Engineering Development is to mature, demonstrate and complete technology to launch SMAW in confined spaces. No additional funding is required to complete this project.	FY 2002 2396	FY 2003 0	FY 2004 0	FY 2005 0	
Totals	30877	58861	28091	52779	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603004A - Weapons and Munitions Advanced Technology					PROJECT L94			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
L94 ELECTRIC GUN SYS DEMO	0	0	19661	19625	19606	0	0	0	

A. Mission Description and Budget Item Justification: This project will demonstrate the state of technology of an integrated electromagnetic armament system at a tactical scale; develop a comprehensive end-to-end system simulation, and resolve system level issues including synchronization/compatibility of twin machines, technology scalability, thermal management, and full-energy system performance. Electromagnetic guns will revolutionize the future battlefield by their unique performance characteristics, such as hypervelocity and stealth launch, their elimination of vulnerable propellants, their synergistic relationship with hybrid electric vehicles, and by their significant reduction in sustainment burden.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Electric Gun System Demo: In FY04, develop detailed armament system design and subsystem designs for Pulsed Power Supply (PPS), launcher, and Integrated Launch Package (ILP); mature models and simulations and demonstrate system simulations including solid model, component performance, end-to-end and system-level performance; perform critical material/component tests including tests on composite rotors and barrels, low-density and high-strength metals, insulation systems, thermal management systems, high energy/high power switches; fabricate and test subscale launcher and ILP; and order long-lead items. In FY05, fabricate prototype PPS rotating machines; test machines (separately); design pulse power supply torque management system and mount; design, fabricate and test full scale launcher, mount, recoil, and ILPs, including both kinetic energy and high-explosive projectiles; interface system simulation with FCS Simulation and Modeling for Acquisition, Requirements, and Training (SMART) process; begin preparations for armament system demonstration at the end of FY06.	0	0	19661	19625
Totals	0	0	19661	19625

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

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BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	220196	264795	210856	205245	158907	163390	188081	192493
221 COMBAT VEH SURVIVABLTY	30883	41284	45713	26806	19563	20406	23114	23942
440 ADV CBT VEHICLE TECH	22279	20945	0	16586	0	48976	60400	56335
441 COMBAT VEHICLE MOBILTY	14182	41683	35933	31630	55476	58318	78843	85037
497 COMBAT VEHICLE ELECTRO	5405	5966	6749	5868	9977	9722	13287	13592
502 HAECO II	0	1191	0	0	0	0	0	0
506 METAL MATRIX COMPOSITES	3744	1431	0	0	0	0	0	0
515 ROBOTIC GROUND SYSTEMS	8921	8456	7428	12248	22709	23702	10116	11214
539 MOBILE PARTS HOSPITAL	5372	7149	0	0	0	0	0	0
53B FUEL CELL AUX POWER UNITS FOR LINE HAUL TRUCKS	0	2859	0	0	0	0	0	0
53D NATIONAL AUTOMOTIVE CENTER - ADV TECH	1619	2574	0	0	0	0	0	0
53E IMPACT TRUCK PROGRAM	3358	3336	0	0	0	0	0	0
53F NAC STANDARD EXCHANGE OF PRODUCT MODEL DATA	2398	2382	0	0	0	0	0	0
53G FUTURE COMBAT SYSTEMS (FCS)	109620	114351	114051	111102	48998	0	0	0
540 IMPROVED HMMWV RESEARCH	2015	0	0	0	0	0	0	0
C66 DC66	4453	3087	982	1005	2184	2266	2321	2373
CA2 TACOM HYBRID VEHICLE DEMO: LITHIUM ION TECH	958	0	0	0	0	0	0	0
CA3 CORROSION PREVENTION AND CONTROL PROGRAM	1343	2430	0	0	0	0	0	0
CA4 VEHICLE BODY ARMOR SUPPORT SYSTEM	3166	2430	0	0	0	0	0	0
CA5 FUEL CATALYST RESEARCH EVALUATION	480	953	0	0	0	0	0	0
CA6 INTEGRATED PROGRAM MANAGEMENT FRAMEWORK	0	953	0	0	0	0	0	0
CA7 RAPID PROTOTYPING	0	1335	0	0	0	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603005A - Combat Vehicle and Automotive Advanced Technology

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 is to mature and demonstrate leap-ahead combat vehicle automotive technologies to realize the Army's vision and enable transformation to the Objective Force. The Future Combat Systems (FCS), the Army's top priority Science and Technology program, is the primary effort funded in this PE; therefore in FY02-FY05, a significant portion of the funds supports the collaborative Army/Defense Advanced Research Projects Agency (DARPA) FCS program. The FCS Memorandum of Agreement (MOA) between the Army and DARPA, signed in February 2000, delineates the technical approach, cost-shared funding profile and responsibilities associated with this partnership. In addition to FCS, this PE supports maturation and demonstration of enabling technologies in the areas of survivability (Project 221), mobility (Project 441) and intra-vehicular digital electronics (Project 497). It also funds efforts to integrate and evaluate diverse vehicle technologies developed 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. Three Advanced Technology Demonstrations (ATDs) are funded. The Future Scout and Cavalry System (FSCS) ATD, a joint US/UK effort completed in FY02, incorporated state-of-the-art sensor, armor, mobility and survivability technologies that are available to the FCS program. The CAT ATD demonstrates multi-mission capable crew stations required for the versatility of the Objective Force. The Robotic Follower ATD (Project 515) will mature and demonstrate an unmanned ground system capability for the FCS and the Objective Force Warrior. The intent is to reduce the soldier's equipment burden, increase survivability and reduce the logistics burden. Hybrid electric and electric vehicle technologies are key enablers for achieving Future Combat Systems (FCS) and Objective Force capabilities. FCS 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 mid-term, pulse power for electrothermal chemical (ETC) guns and electromagnetic (EM) armor will be matured and demonstrated. 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. This program will demonstrate critical power, propulsion and electric systems, including energy storage, power distribution and pulse forming networks (PFNs). This PE is managed by the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC), a subordinate organization of the Tank-Automotive and Armaments Command (TACOM), located in Warren, MI. This PE adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles with oversight and coordination provided by the Joint Directors of Laboratories. Work in this program element is related to, fully coordinated with PE 0602601A (Combat Vehicle and Automotive Technology) and 0602618 (Ballistics Technology). The 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 work cited is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. No Defense Emergency Response Funds were provided to the program. This program supports the Objective Force transition path outlined in the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603005A - Combat Vehicle and Automotive Advanced Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	225960	234978	218157	181468
Current Budget (FY 2004/2005 PB)	220196	264795	210856	205245
Total Adjustments	-5764	29817	-7301	23777
Congressional program reductions		-9018		
Congressional rescissions		-5126		
Congressional increases		57900		
Reprogrammings	324	-6721		
SBIR/STTR Transfer	-6088	-7218		
Adjustments to Budget Years			-7301	23777

Change Summary Explanation:

Significant Changes:

FY05 - Funds increases in FCS engine, Pulse Power, Robotics, and Advanced Mobile Integrated Power.

FY03 (\$57900) Congressional Adds:

Truck Research, Project TBD (\$1000)

Composite Body Parts – CAV Technology Transition, Project 440 (\$2100)

Digital Human and Virtual Reality for Future Combat System, Project 440 (\$3500)

Hybrid Electric Drive, Project 441 (\$1500)

Aluminum Reinforced MMC's for Track Shoes on Ground Based Vehicles, Project 506 (\$1500)

Advanced Thermal Management System, Project 440 (\$1000)

Geisel, Project 502 (\$1250)

Integrated Program Management Framework, Project CA6 (\$1000)

Ultra-high Performance Hybrid Structures and Armors, Project CA4 (\$2550)

Electrochromatic glass for combat vehicles, Project 53D (\$1700)

Future Scout and Cavalry Vehicle Demonstration, Project 440

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)**February 2003****BUDGET ACTIVITY****3 - Advanced technology development****PE NUMBER AND TITLE****0603005A - Combat Vehicle and Automotive Advanced
Technology**

(\$8500)

Objective Force Cost Module, Project 440 (\$3600)

Fuels catalyst research and evaluation, Project CA5 (\$1000)

Rotary, Multi-fuel, Auxiliary Power Unit Development Program, Project 53B (\$3000)

IMPACT, Project 53B (\$3500)

NAC Standardized Exchange of Product Data, Project 53F (\$2500)

Mobile parts hospital, Project 539 (\$7500)

Rapid prototyping, Project CA7 (\$1400)

Hybrid electric vehicles, Project 441 (\$5250)

Pacific Rim Corrosion Project, Project CA3 (\$2550)

Tracked Hybrid Electric Vehicle, Project 441 (\$1000)

Turbo Fuel Cell Engine, Project 440 (\$1000)

Projects with FY2003 Congressional Adds and no R-2A not listed/defined due to space limitations.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology					PROJECT 221			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
221 COMBAT VEH SURVIVABLTY	30883	41284	45713	26806	19563	20406	23114	23942	

A. Mission Description and Budget Item Justification: This project matures and demonstrates vehicle survivability technologies essential for FCS and the Objective Force, including: 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 protection without reliance on heavy passive armor. This challenge will be met using a layered approach, substituting long-range situational awareness, multi-spectral signature reduction, AP systems and advanced lightweight armor for conventional armor. Initial AP efforts demonstrate technologies needed 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 (CM) warhead, and soft kill electronic warfare (EW) spoofers and jammers while the vehicle is on-the-move (OTM). Defeat of Kinetic Energy (KE) threats offers a substantial challenge due to size and speed of the threat. The goal of the AP against KE effort is to defeat KE with a multi-purpose hard kill CM warhead. The project uses component technologies from PEs 0602601A, 0602120A, 0602618A and 0602624A. 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, smart and ceramic armors integrated with advanced composite and laminate structures. Lightweight, integrated armor technologies, including components from PE 0602601A, 0602618A and 0602105A, will be demonstrated by ballistic testing of quarter vehicle sections to validate performance versus weight as required for frontal and side armor protection. The signature management effort will improve existing multi-spectral signature modeling tools, characterize hardware performance, and provide inputs to FCS virtual prototyping. The technical goal is to demonstrate 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. Protection for sensors from laser attack is addressed. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT			
3 - Advanced technology development	0603005A - Combat Vehicle and Automotive Advanced Technology	221			
<u>Accomplishments/Planned Program</u>		FY 2002	FY 2003	FY 2004	FY 2005
Active Protection against CE – In FY 02, tested active protection hard kill and EW jamming against live ATGMs and RPGs; demonstrated ability to defeat RPGs, ATGMs and tank-fired HEAT rounds; demonstrated defeat of two ATGMs fired nearly simultaneously, using hard kill on one and soft kill on the other. These demonstrations were accomplished with a static vehicle. In FY 03, design and integrate radar and CM launcher stabilization required for operation of the AP system OTM; demonstrate hard kill ATGM defeat from a moving test vehicle; develop and test an extended range tracking radar sensor; develop a more capable CM warhead and begin design of cueing sensor radar for hemispherical detection of threat munitions. In FY04, integrate and test explosive warhead, low cost threat warning sensor, and search radar against tank-fired HEAT, ATGMs, RPGs, and Fallers/Flyers; integrate complete hemispherical CE AP system onto test vehicle for end-to-end OTM testing in an operational environment; and mature OTM algorithms for AP motion compensation. In FY05, mature OTM algorithms for EW; test Multi-Function EW Countermeasure; test OTM full hemispherical, integrated AP/EW system.		20321	32041	27213	7189
Active Protection against KE (Full Spectrum Active Protection) - In FY 02, conducted over 100 CM warhead/threat interaction tests to identify a single warhead design that has the potential to defeat all threat classes; identified three different countermeasure configurations: blast, blast/fragment, and multiple explosively formed penetrator warhead configurations with potential to be effective against KE and all threat classes. In FY 03, test and validate CM interceptor and warhead fusing technologies; perform CM warhead fly off tests against KE, CE and ATGM threats and improve model fidelity. In FY04, demonstrate FSAP close-in layered shield against near field RPG, DPICM, and man portable ATGM threats. Complete FSAP radar design, fabricate and demonstrate e-scan radar, select and demonstrate final interceptor with proximity fuse and countermeasure against the full spectrum of threats, and complete the final FSAP system design. Mature, miniaturize and ruggedize selected technologies for system integration. In FY05, complete FSAP system design, fabricate, integrate, and demonstrate the system in a dynamic environment against all threat classes.		5562	5500	5000	11672
Ballistic Protection for Block II - In FY04, complete EM armor component development, build vehicle quarter section ballistic targets and range test these fully integrated 3rd generation armor/structure designs against FCS Block II threats and demonstrate: armor/structural capability at FCS weights; integration of critical components; and armor/structural reliability. In FY05, conduct ballistic range tests to optimize and validate the best achievable integrated armor packages for lightweight test platforms.		0	0	8500	3000

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BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology	PROJECT 221			
<u>Accomplishments/Planned Program (continued)</u>					
Signature Management - In FY02, developed improved virtual modeling tools and fabricated full-scale test hardware to validate virtual modeling results, completed verification, validation and accreditation on Thermal Predictive Model version 7.0; VVA proceeding with other models. In FY03, deliver proof of principle virtual prototyping signature field test capability to LSI and contractors and perform breadboard testing to quantify field performance and commence FCS signature modeling predictions. In FY04, deliver enhanced modeling capability including exhaust plume signature effects and integration with synthetic imagery, optimize field performance of hardware for FY05 validation tests. In FY05, perform full-scale validation tests and deliver to LSI full capability signature management virtual models, and provide robust signature modeling capability to Joint Virtual Battlespace.	<u>FY 2002</u> 5000	<u>FY 2003</u> 3743	<u>FY 2004</u> 5000	<u>FY 2005</u> 4945	
Totals	30883	41284	45713	26806	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology					PROJECT 440			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
440 ADV CBT VEHICLE TECH	22279	20945	0	16586	0	48976	60400	56335	

A. Mission Description and Budget Item Justification: This project demonstrates the operational potential, technical feasibility and maturity of advanced combat vehicle technologies through integrated demonstrations of subsystems, systems, and system of systems. In FY 2002 Army funds for the collaborative Army/DARPA FCS effort were transferred from this project to Project 53G to provide better visibility (see project 53G for a description of the FCS program). Work performed under this project (440) demonstrates innovative concepts, combat vehicle configurations, enabling technologies and integration techniques. All demonstrations include User and developer teaming in field and/or laboratory environments. Computer simulations and hardware demonstrations (subscale and full-scale) are conducted to accomplish a more rapid and seamless transition of advanced technologies into systems applications. The FSCS ATD, completed in FY02, integrated advanced sensors, survivability, mobility and communications technologies into robust vehicle platforms. The integrated prototype assets delivered to the government demonstrated the technical maturity and the ability to successfully integrate technologies. The demonstrators underwent technical testing with a limited operational evaluation to assist the Training and Doctrine Command in developing warfighting tactics, techniques, and procedures. Technologies developed under this program and the lessons learned about integrating FSCS technologies on a C-130 transportable platform were made available to the FCS LSI to reduce risk and accelerate FCS development. The Future Tactical Truck System (FTTS) effort is a program to build medium support and utility vehicle demonstrators and evaluate them in a field environment. The program evaluates future tactical vehicle technologies including high power density engines, hybrid electric propulsion, electric traction motors, advanced power distribution & control, advanced battery storage, independent & variable height suspension, semi-active/selectable damping suspension, advanced digital driver displays & controls, and vehicle structure & cab designed for survivability and mine protection. New methods and techniques for material handling will be demonstrated. The demonstrations will be supported by virtual prototyping through the use of 3D CAD models and analysis. No Defense Emergency Response Funds were provided to the project. This system supports the Objective Force transition path of the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603005A - Combat Vehicle and Automotive Advanced Technology		440	
<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Future Scout and Cavalry System (FSCS) ATD - In FY02, this effort completed FSCS Advanced Technology Demonstration (ATD) Program which demonstrated the feasibility and operational potential of a lightweight scout vehicle platform in various areas including survivability, target acquisition, mobility, deployability, and lethality, by integrating scout specific technologies with complementary advanced vehicle technologies. More specifically, this program addressed issues including survivability strategies, sensor capabilities, and mobility enhancements. Technology risk reduction and subsystem maturation activities initiated during the FSCS ATD were available for transition into the Future Combat System (FCS) Program.	15167	0	0	0
Water Recovery from Vehicle Exhaust for FCS - In FY03, initiate development and demonstration of a system to recover water from vehicle exhaust gases for logistics burden reduction for FCS using technology being developed in PE 0602601 Project AH91.	0	1930	0	0
Future Tactical Truck System (FTTS) – In FY05, build multiple medium support and utility vehicle demonstrators/prototypes; test vehicles in a field environment to evaluate performance and military utility. This effort will be supported by virtual prototyping through the use of 3D models and analysis. This project uses technology developed in PE 0602601 Project AH77.	0	0	0	16586
Future Scout and Cavalry Vehicle Demonstration - In FY03, this one-year Congressional Add continues risk reduction and subsystem maturation activities initiated during the FSCS Advanced Technology Demonstration (ATD) Program. These activities are at an integrated system and subsystem level, focusing on transition to the Future Combat Systems (FCS) Program. No additional funds are required to complete this project.	0	8208	0	0
Composite Body Parts – In FY02, this one year Congressional Add supports and completes the adaption and evaluation of HMMWVs with composite construction. No additional funds are required to complete this project.	1345	0	0	0
Combat Vehicle Research in Weight Reduction – In FY02 this one-year Congressional Add supports and completes development and evaluation of low-cost composites using intelligent Vacuum Assisted Resin Transfer Molding (VARTM) process control and low cost tooling technology for thin gage sheet metal panel replacement for trucks and other tactical vehicles. No additional funds are required to complete this project.	5767	0	0	0
Digital Human & Virtual Reality for FCS – In FY03, this one-year Congressional Add developments digital human modeling/simulation tools and applications that currently do not exist and are needed to analyze & evaluate the human interface for digital models of vehicle systems. No additional funds are required to complete this project.	0	3378	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive
Advanced Technology**

PROJECT

440

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
Composite Body Parts CAV Technology Transition - In FY03, this one-year Congressional Add: expands manufacturing trials to all variations of HMMWV doors, the 5 ton truck hood, HMMWV hood front corners, and 2 1/2 ton and 5 ton truck doors; conducts 12-month field evaluations of more than 500 composite body parts; and provides small, initial population of 2 1/2 ton hoods for immediate field use to solve logistics No-Source Problem. No additional funds are required to complete this project.	0	2027	0	0
Turbo Fuel Cell Engine - In FY03, this one-year Congressional Add develops materials, manufacturing processes, and tube interconnections for solid oxide fuel cell tubes, which are the core of a turbo-charged fuel cell vehicle engine. No additional funds are required to complete this project.	0	964	0	0
Objective Force Cost Module - In FY03, this one-year Congressional Add develops a collaborative information and budget software tool for application to the management of programs being developed for the Objective Force. No additional funds are required to complete this project.	0	3474	0	0
Advanced Thermal Management System - In FY03, this one-year Congressional Add funds development of advanced pumping technologies for parasitic reduction combined with advanced cooling technology for thermal control. No additional funds are required to complete this project.	0	964	0	0
Totals	22279	20945	0	16586

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology						PROJECT 441	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
441 COMBAT VEHICLE MOBILTY	14182	41683	35933	31630	55476	58318	78843	85037

A. Mission Description and Budget Item Justification: This project matures and applies advanced mobility and electric technologies to next generation vehicles and will demonstrate increased vehicle performance and capability. It enables light, agile, deployable, fuel efficient and survivable ground combat vehicles needed for FCS and the Objective Force. The main efforts funded by this project are Hybrid Electric Vehicle (HEV) Propulsion Technologies, FCS Engine, Advanced HEV Technologies, and Pulse Power. HEV develops and matures components, sub-systems and systems for hybrid-electric vehicles including power distribution and storage systems, in-hub wheel 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 Combat Hybrid Propulsion System (CHPS) Systems Integration Laboratory (SIL) that simulates combat vehicles weighing less than 20 tons. Hybrid Electric Vehicles offer: improved automotive performance, significant reduction in fuel consumption (20-50% savings over today's combat vehicles), silent watch and silent mobility, and vehicle design flexibility. The 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 HEV effort is enhanced significantly with infusion of FY03 funds to ensure that this critical technology will be mature enough to use in FCS block I vehicles. The goal of the FCS Engine effort is to mature and demonstrate prime power (engines) 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, commercial engine. The Army develops and matures high power density engines because commercial engines lack robustness and power density required for Army vehicles. In FY02 and FY03, both internal combustion diesel engines and turbines are being pursued as FCS candidates. The goal of the effort is to demonstrate a prototype engine system with power density of no less than 6 hp/cu.ft. in FY05. The Advanced HEV Technologies will seek further increases in vehicle mobility, efficiency and mission capability without increasing vehicle weight and volume. This project will apply advanced technologies (in-hub 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. Army efforts in hybrid electric drive leverage two prior joint Army/DARPA programs, CHPS and the Electric Drive Vehicle Demonstration Program, and component technologies from PE 0602601A and PE 0602618A. The Pulse Power effort will build on work performed under the CHPS HEV initiative. Compact, high power density Pulse Forming Networks (PFNs) will enable more lethal electric weapons and more effective protection systems. The goal is to accelerate development of high power density, capacitor-based PFNs for electro-magnetic armor and weapons for FCS Block II and beyond. No Defense Emergency Response Funds were provided to this project. This program supports the Objective Force transition path of the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology	PROJECT 441
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
HEV FCS Propulsion – In FY02, operated basic hybrid electric power management system in the Combat Hybrid Power System (CHPS) SIL at 300 and 600 volt levels, emulating the full range of vehicle operating conditions, completed and installed 300kW lithium ion battery, fabricated electromagnetic (EM) armor simulator; and completed 200kW/cu.m multi-functional PFN and demonstrated 100kJ/pulse power discharge into simulated electrothermal chemical (ETC) load. In FY03, there is a major focus on acceleration of hybrid electric/hybrid technologies to support FCS block I. Downsize components to fit the FCS-class ground vehicles (<20 tons) using a volume goal of 80 cubic feet for the power pack; configure SIL for FCS component testing; demonstrate power levels, control techniques and unique hybrid electric power architecture at the 750 volt level. Demonstrate pulse power at 200 kJ for both EM armor and ETC gun, and test traction motors; develop electric suspension to increase speed over cross country terrain by 70%; document findings/results and transition mature components and subsystems to FCS LSI for Block I. In FY04, implement strategy for upgrading hybrid electric technologies for potential FCS insertion; advance power densities of compact FCS components to objective (goal) power levels (200 kW per cu.m).	4742	16923	2943	0
FCS Engine - In FY02, contracted for a competitive engine demonstration program with three different engine companies to implement designs to double commercial off-the-shelf engine power density in the same space and weight limitations imposed by FCS prime power needs. In FY03, demonstrate the power density potential of the three competing engines through preliminary hardware testing in the laboratory and down select to one engine. In FY04, the engine will undergo performance improvement, mechanical durability development and 50 hour NATO durability demonstration. It will also be optimized for hybrid electric application and reconfiguration design begun for specific FCS vehicle application. In FY05 the reconfigured design will be built and matured for 400 hour NATO demonstration.	9440	16314	10000	9963
Advanced HEV Technologies - In FY04, demonstrate improved electric in-hub motor with reduced weight and volume characteristics; develop SiC motor inverter for 10 kW level for improved power density; test improved Li-Ion batteries at 750 volts to improve efficiency and reduce volume; develop and demonstrate Si/SiC 50 kW DC-DC converter for higher frequency and reduced volume; develop all SiC 10 kW DC-DC converter and scale to 50 kW; and adapt lab capabilities to emulate full electric hybrid system for FCS Block II. In FY05, demonstrate 50 kW SiC motor inverter; develop Li-Ion batteries for 1000 volts; and demonstrate improved hub motor and active electric suspension in FCS Block II surrogate.	0	0	18086	17194

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology	PROJECT 441
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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Pulse Power - In FY04, develop: high energy density pulse forming Network (PFN) at 6.6 kJ/ft3; hybrid Si/SiC DC-DC converter for pulse power PFN application; and sealed vacuum discharge switches for pulse power. In FY05, incorporate SiC switches into PFN for greater energy density and develop high frequency SiC DC-DC converter for pulse forming network. This is a collaborative TARDEC/ARL effort.	0	0	4904	4473
Hybrid Electric Drive - The objective of this one-year Congressional Add is to support the systems engineering study that makes an assessment of hybrid electric drive systems on military and commercial trucks to identify the technologies and configurations within the design space that will support both a military and commercial requirement. No additional funds are required to complete this project.	0	1635	0	0
Hybrid Electric Vehicles - The objective of this one-year Congressional Add is to build light and medium HEV demonstration platforms that will be evaluated in the field by the warfighter to determine the impact the advanced technologies will have on the warfighters' ability to reduce the logistics footprint while meeting mission requirements. No additional funds are required to complete this project.	0	5721	0	0
Tracked Hybrid Electric Vehicle - The objective of this one-year Congressional Add is to demonstrate the system integration and synergistic effects of Command & Control electronics integrated into a hybrid electric vehicle having on-board power generation and storage. No additional funds are required to complete this project.	0	1090	0	0
Totals	14182	41683	35933	31630

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology					PROJECT 497			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
497 COMBAT VEHICLE ELECTRO	5405	5966	6749	5868	9977	9722	13287	13592	

A. Mission Description and Budget Item Justification: This project matures and demonstrates intra-vehicle electronics hardware and software, producing a multifunctional crew station that will result in increased crew efficiencies/performance and/or reduced crew size. In addition, the project advances open system architectures for ground combat vehicles that will allow the vehicle crew station to be adapted for a variety of FCS and Objective Force ground platforms. The primary effort is the CAT 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, up to 30% reduction in software and modified commercial power architecture. In FY03 and FY06, vehicle demonstrations are planned to prove out configurations of multi-role crew stations that will enable a two-man crew to perform functions associated with fighting the battle, reconnaissance, logistics and sustainment, as well as unmanned asset control in a test-bed with reconfigurable crew stations. 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 the FCS. For the period FY05-FY09, activities will focus on advanced multifunctional ground vehicle crew station concepts and technologies for FCS Block II and III. This will include an integrated Section Level Associate with a Vehicle Commander's Associate, improved and increased span of control for mixed initiative robotic operations, collaborative vehicle operations for workload management, and continued maturity of auto driving aids and embedded simulation for battlefield visualization and fully integrated virtual test and evaluation. No Defense Emergency Response Funds were provided to the project. This program supports the Objective Force transition path of the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology	PROJECT 497
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Crew Integration and Automation Testbed ATD: In FY02, defined semi-autonomous driver's aid and adapted cognitive decision aid; matured route planning for mobile testbed evaluation; and designed and integrated a Systems Integration Laboratory which led to the implementation of a crew station and electronic architecture for FCS technology evaluated by FCS system integrator. In FY03, conduct an unmanned combat demonstration in a virtual experiment with an advanced crew station; complete cognitive decision aid and soldier in-the-loop test crew station and embedded simulation. In FY04: integrate and conduct field testing of advanced crew station, electronics architecture and embedded simulation component technologies; add operator's intent inferencing and system automation to the commander's associate; demonstrate SMI and decision aids for UAV control; augment combat vehicle driver's aid to utilize pedestrian/dismounted soldier identification; and mature a distributed digital indirect vision system for closed hatch vehicle driving operations. In FY05: mature technology to mix live and virtual imagery, enabling on-the-move embedded simulation and mission rehearsal; implement and test ground vehicle autopilot capability; mature a distributed workload management system across manned/unmanned assets that support the FCS network centric concept; and procure/fabricate advanced hardware needed to test the full range of ATD exit criteria in the following year.	5405	5966	6749	5868
Totals	5405	5966	6749	5868

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology					PROJECT 515			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
515 ROBOTIC GROUND SYSTEMS	8921	8456	7428	12248	22709	23702	10116	11214	

A. Mission Description and Budget Item Justification: This project matures and demonstrates unmanned ground vehicle technologies for the FCS and other Objective Force ground systems. This project demonstrates sensor technologies/perception hardware, software and robotic control technologies required to enable unmanned ground vehicle (UGV) systems to maneuver with minimal human intervention, on-and off-road, at militarily significant speeds. Mature technologies are incorporated in UGV technology demonstrators, whose performance can be evaluated for multiple tactical and logistics applications. Technical challenges addressed include: obstacle avoidance, perception limitations, intelligent situational behaviors, command and control, frequency of human intervention, and adverse weather operation. In the near term, the Robotic Follower ATD focuses on UGVs that follow other vehicles directly or follow a designated path, requiring little human intervention. The Demo III experimental UGV (XUV) and a converted Interim Armored Vehicle (robotic IAV) will serve as test vehicles. The goals for the ATD are: 5-200km separations between leader and follower, 160-750km range, obstacle detection for objects 0.3 x 1sq.m. in size, and minimum operator intervention (1 per km @20km/hr). This ATD is a cooperative effort between TARDEC and the Army Research Laboratory (ARL), using component technologies developed in PE 0602618A. The schedule has been accelerated to provide demonstration of Follower UGVs for FCS block I in FY03. The ATD is scheduled to complete in FY05. Potential applications include re-supply vehicles and soldier "mules" that may be used to reduce each dismounted soldier's carried load by 20 to 25 pounds. In the farther term, the project will advance unmanned ground vehicle technologies to enable semi-autonomous and autonomous operation and to expand the mission envelope of UGVs for FCS block II and beyond. Potential missions/functions include medical supply and evacuation, scout/reconnaissance and remote weapons delivery. This project was established by the Army in recognition of the increasing maturity of robotics technology, growing user interest in unmanned platforms, and an urgent need to make the force lighter, more agile strategically and tactically and more survivable. The approach builds upon previous and ongoing investments such as the Demo III program, conducted under the Joint Robotics Program Office, and the DARPA UGV program. Beyond completion of the Robotic Follower ATD, this project will continue to be executed in cooperation with ARL. No Defense Emergency Response Funds have been provided to this project. This program supports the Objective Force transition path of the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology	PROJECT 515
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Robotic Follower Block I: In FY02, using Stryker Infantry Carrier variant testbed added robotic control architecture and autonomous mobility algorithms to convert an Interim Armored Vehicle (IAV) from manned to unmanned vehicle; demonstrated low speed, line of sight capability to follow at 20kh and 500m separations. In FY03, obtain speeds of 65km/hr on primary roads and cross-country following speed of 20km/hr; complete software development of terrain registration geometric planning and road following; conduct war fighter experiments, testing and demonstrations of on-road, high speed, line of sight IAV follower; complete cross country, low speed follower for the dismounted soldier using XUV. In FY04, mature sensor data/map registration and trail detection technologies to obtain following speeds of 65km/hr on primary roads and 40km/hr cross-county. Integrate enhanced autonomous mobility algorithms from ARL Semi-autonomous Robotics effort for FCS. Develop robotic virtual development and test environment to enable hardware in the loop modeling and simulation. Conduct engineering evaluations and soldier operational testing of follower capability in logistic and tactical mission scenarios. Continue technology transition to FCS SDD Unmanned System developers and Objective Force Warrior teams. In FY05, develop/incorporate intelligent situational behavior to significantly increase separation times and distances and assist in prevention of communication loss or mobility kill. Develop/integrate vehicle tracking capability to enable operation within traffic.	8921	8456	7428	6979
Semi-Autonomous Robotic Mobility Demonstrations: In FY05, mature and demonstrate advanced route planning/route following algorithms, robust perception systems for obstacle avoidance, intelligent navigation and control systems, component technologies and software developed under PE 0602618; apply new component technologies to UGV demonstrators; design and conduct relevant field demonstrations of semiautonomous and autonomous UGVs to show capability to perform time consuming, dirty and dangerous missions.	0	0	0	5269
Totals	8921	8456	7428	12248

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology					PROJECT 53G			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
53G FUTURE COMBAT SYSTEMS (FCS)	109620	114351	114051	111102	48998	0	0	0	

A. Mission Description and Budget Item Justification: This project funds the Army's share of the Army/DARPA FCS program and other FCS key component technologies. FCS, the centerpiece of the Army's strategy to transform to the Objective Force, is a multi-functional family of systems that will be capable across the full spectrum of conflict and range of operations. The product of this project will be a family of systems that will meet the Army's transformation goal to have a responsive ground force that is superior in all aspects. The FCS project responds to an approved Organizational and Operational Plan and draft Operational Requirements Document developed by the U.S. Army Training and Doctrine Command (TRADOC). In September 2001 the Army decided to accelerate the FCS program to enter System Development and Demonstration (SDD) in 2003 vs. 2006. The program is on schedule to complete the Concept and Technology Demonstration (C&TD) phase in 2003 for the initial set of systems. In March 2002 DARPA issued an Other Transactions Agreement for a Lead Systems Integrator (LSI). In partnership with the Government the LSI will develop, define, refine, assess and validate a FCS concept and perform the work required to complete Milestone (MS) B, laying the foundation for a smooth transition to SDD. First Unit Equipped (FUE) for FCS with threshold capability is planned for 2008 and Initial Operational Capability, for 2010. The concept design for the first of the anticipated upgrades to achieve an objective capability will begin in 2004. DARPA is the executive agent for the FCS program in the C&TD phase. Funds in this project and those in PE 0602601/HH7 are provided to and executed by DARPA in accordance with Memoranda of Agreement (MOA). The first MOA, signed in February 2000, provided a basis for three distinct types of efforts: 1) Concept Development, Modeling and Simulation (M&S) and Surrogate Exercises; 2) Design/ Demonstration; and 3) DARPA-executed Enabling Technology efforts. The LSI executes the Design/Demonstration effort. Each Enabling Technology effort is managed as a distinct program at DARPA. Programs include: Beyond-line-of-sight (BLOS) Networked Fires Weapon (NetFires); Maneuver Command, Control and Communications; Maneuver and BLOS Surveillance and Targeting Systems; and Robotic Unmanned Ground Vehicles. Under the initial MOA (Phase I) the Army's planned share of the Army/DARPA collaborative FCS program is: \$107M (FY2002), \$122M (FY2003), \$114M (FY2004) and \$111M (FY2005). Due to the program acceleration and early transition to SDD, the intent of the original MOA has been met. Therefore, the Army and DARPA are negotiating a new MOA (Phase II) to continue the collaborative program and provide advanced technologies in support of the FCS program decisions in the FY2006 timeframe, either for technology insertion prior to FUE or future FCS upgrades. Phase II MOA primary objectives are: 1) conduct and further define Concept Development, M&S and Surrogate Exercises to assure emerging enabling technologies are on the path for inclusion in FCS; 2) continue maturation and demonstration of high payoff technologies from selected programs begun under the original MOA for insertion prior to MS C in FY2005; and 3) provide additional advanced technologies that will lead to increased capabilities in future FCS versions. The new MOA will use the FY2004 and FY2005 funding already slated for the DARPA/Army partnership. No Defense Emergency Response Funds were provided to the project. This project supports the Objective Force transition path of the Transformation Campaign Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603005A - Combat Vehicle and Automotive Advanced Technology		53G	
<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>FCS Design/Demonstration (Phase I): In FY02, conducted competition for LSI and awarded an Agreement in March 2002; developed and defined initial system of systems architecture; conducted analyses to determine maturity of technologies; finalized FCS organizational, operational and materiel concepts; and established an advanced collaborative environment to support M&S throughout the program. In FY03, finalize detailed design for threshold FCS; plan and conduct key tests and demonstrations of critical elements to support MS B decision; validate M&S tools developed specifically for FCS and use these to support MS B decision; and transition FCS initial systems to SDD.</p>	28000	50000	0	0
<p>Enabling Technologies (Phase I): In FY02-03, funds provided to DARPA for Army share of technology maturation and developments programs listed below. In addition \$18.82M was provided from PE 0602601/HH7 in FY02 to meet the Army's commitment according to the MOA. More specific information on the DARPA programs and their accomplishments/plans may be found in the DARPA exhibits.</p> <p>NetFires: Designs, builds and demonstrates missiles launched out of a container to provide non-line-of-sight lethality for FCS. In FY02, finalized missiles design, conducted flight tests. In FY03, transition program management to Army.</p> <p>Maneuver Command, Control, and Communications: Evaluate novel cooperative engagement, cooperative survivability and command and control strategies to help TRADOC develop FCS-based tactics, techniques and procedures.</p> <p>BLOS Surveillance and Targeting Systems: Mature selected lethality, survivability, mobility and communications technologies for transition to SDD in FY03.</p> <p>JigSaw: Designs, builds and demonstrates a Laser Detection and Ranging (LADAR) system that will allow warfighters to "see" through dense vegetation and under a forest/jungle canopy. In FY02, finalized LADAR system design and began hardware build. In FY03, evaluate LADAR system in limited field-testing.</p> <p>Perceptor: Develops and demonstrates sensors and perception algorithms for autonomous navigation of unmanned ground vehicles (UGVs). In FY02, completed 4 field experiments in different terrains to evaluate UGV perception approaches. In FY03, upgrade perception prototypes and examine performance in degraded operating conditions.</p> <p>Unmanned Ground Vehicle: Designs, builds and demonstrates 600 kilogram and 6000 kilogram UGVs to perform a variety of functions in the FCS-equipped force. In FY02, competed and awarded system design contact. In FY03, evaluate UGVs in limited field test.</p>	59726	61276	0	0
<p>Enabling Technologies (Phase I): In FY02, Army share of costs beyond original MOA. Enhanced and accelerated the DARPA NetFires effort; increased scope of work for the LSI to accommodate program acceleration.</p>	15831	0	0	0
<p>Objective Force Task Force (OF-TF): Funds OF-TF efforts to conduct FCS analyses and to ensure that FCS can be integrated successfully into the Objective Force.</p>	6063	3075	51	102

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603005A - Combat Vehicle and Automotive Advanced Technology	PROJECT 53G			
<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>	
FCS Design/Demonstration (Phase II): In FY04, define, evaluate and select technologies for upgrade from threshold to objective capabilities; further develop and define FCS spiral development concept; perform trade studies, analyses and tests on technologies/systems for future upgrades. In FY05, demonstrate improved performance afforded by advanced technologies and provide detailed plan for FCS upgrades.	0	0	40000	40000	
Enabling Technologies (Phase II): In FY04-05, pursue new enabling technology efforts focused on three critical areas: 1) Find the Enemy, 2) Autonomy with Intent, and 3) Affordable Combat Identification. Find the Enemy will provide capabilities to better defeat camouflage, concealment, and deception and exploit situational awareness through improved sensors, assured communications, intelligent decision aids, and data fusion. Autonomy with Intent will focus on improving unmanned systems' (UAVs and UGVs) ability to function while minimizing soldier workload and interaction. Affordable Combat Identification will increase force survivability by improving identification of battlefield entities for high OPTEMPO in complex terrains and intermingled forces. Also, some funding to complete key efforts initiated in Phase I.	0	0	74000	71000	
Totals	109620	114351	114051	111102	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603006A - Command, Control, Communications Advanced Technolo

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	33272	6814	10379	13073	14539	15106	11297	6559
247 TAC C4 TECHNOLOGY INT	13451	0	0	0	0	0	0	0
257 DIGITAL BATTLEFLD COMM	12142	2722	0	0	0	0	0	0
588 HIGH ALTITUDE AIRSHIP ACTD	0	0	2949	2944	0	0	0	0
592 SPACE APPLICATION TECH	7679	4092	7430	10129	14539	15106	11297	6559

A. Mission Description and Budget Item Justification: This program matures and demonstrates advanced space technology applications for the Army's Objective Force. 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 airship structure, propulsion, flight control, and power generation technologies to carry heavy multi-mission payloads for airship long dwell time at 70,000 feet in High Altitude Airship ACTD. This program supports the Objective Force transition path of the Transformation Campaign Plan. 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.

No Defense Emergency Response Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603006A - Command, Control, Communications Advanced Technolo

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	33176	4826	5236	5670
Current Budget (FY 2004/2005 PB)	33272	6814	10379	13073
Total Adjustments	96	1988	5143	7403
Congressional program reductions				
Congressional rescissions		-649		
Congressional increases		2800		
Reprogrammings	912	-39		
SBIR/STTR Transfer	-816	-124		
Adjustments to Budget Years			5143	7403

Change Summary Explanation: Funding – FY 2004/2005: Funds increased to support Distributed Imaging Radar Technology, Space Control Counter ISR, and High Altitude Airship ACTD efforts.

FY03 Congressional Add:

Networking Environment for C3 Mobile Services, Project 257 (\$2800).

Projects with no R-2A:

(\$2761), Networking Environment for C3 Mobile Services, Project 257. The objective of this one year Congressional Add is to mature network and communications technology options. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603006A - Command, Control, Communications Advanced Technolo				PROJECT 588			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
588 HIGH ALTITUDE AIRSHIP ACTD	0	0	2949	2944	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 70,000 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 Objective Force. Other agencies providing additional support and funding include Missile Defense Agency, Office of Home Land Security, and Office of the Secretary of Defense. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- In FY04, mature and integrate HAA ACTD airframe, power generation, propulsion flight control, and C2 subcomponent technologies, define payload interfaces, conduct subcomponent ground test, and complete airship flight qualification. In FY05, complete airship and payload integration; demonstrate airship/payload prototype for one month at 70,000 feet.	0	0	2949	2944
Totals	0	0	2949	2944

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603006A - Command, Control, Communications Advanced Technolo					PROJECT 592			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
592 SPACE APPLICATION TECH	7679	4092	7430	10129	14539	15106	11297	6559	

A. Mission Description and Budget Item Justification: This project matures and demonstrates advanced space technology applications for the Army's Objective Force. 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. This program supports the Objective Force transition path of the Transformation Campaign Plan. This program is designated as a DoD Space Program. No Defense Emergency Response Funds were provided to the program.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- In FY02, completed Battlefield Ordnance Awareness technical requirements definition and provide to DoD space based infrared system developers. Performed technical risk reduction for transition to ground platform by updating algorithms and test for small caliber weapons.	3692	0	0	0
- In FY02, demonstrated an integrated Overhead Sensor on a ground tower platform and measured performance against camouflaged, concealed tactical targets. In FY03, complete Long Wave Infrared/Acoustic Optical Tunable Filter performance assessment.	1105	46	0	0
- In FY04, perform initial testing and algorithm assessment of the Distributed Imaging Radar Technology concept using existing synthetic aperture radar. 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.	0	0	3176	4139
- 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.	0	0	0	2946

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603006A - Command, Control, Communications Advanced Technolo	PROJECT 592
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	FY 2002	FY 2003	FY 2004	FY 2005
<u>Accomplishments/Planned Program (continued)</u> - In FY02, matured formal Space Surveillance software coding of algorithms, user interface design, and demonstrate threat assessment techniques on ground-to-space surveillance radar. In FY03, continue to mature formal Space Surveillance software coding of algorithms, user interface design, and demonstrate threat assessment techniques on ground-to-space surveillance radar. In FY04, complete hardware/software integration, test, and demonstrate near real time threat assessment in a simulated operational environment; and transition technology to ground-to-space surveillance radar.	2882	3172	2500	0
- In FY04, assess Counter ISR technology miniaturization options and develop technical requirements for the optimal demonstration configuration. In FY05, develop miniaturized ISR technology package brass board design with associated automation software.	0	0	1754	3044
- In FY03 initiate airship platform design and define technical requirements for project 588 High Altitude Airship ACTD.	0	874	0	0
Totals	7679	4092	7430	10129

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603007A - Manpower, Personnel and Training Advanced Technolo							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	3077	7663	4931	7158	6854	7033	7095	7193
792 PERSONNEL PERFORMANCE & TRAINING	3077	4422	4931	7158	6854	7033	7095	7193
79A ARMY TRAINING SUPPORT CENTER	0	3241	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this program element (PE) is to develop and demonstrate advanced soldier-oriented technologies to enhance soldier and unit performance in the Army's transformation to the Objective Force. A key goal of this program is the reduction of training and other personnel costs through the development of effective training strategies that incorporate appropriate mixes of live, virtual, and constructive simulations. Research and development (R&D) efforts include designing new ways to efficiently develop collective training; developing and demonstrating prototype training methods and programs that improve mission performance; devising training strategies using distributed training technology to conduct multi-site training, assessment, and feedback; and evaluating the effectiveness of compressed gunnery training strategies for the Reserve Component. R&D will also design innovative methods and technologies to develop effective leaders for small team operations and for developing Battle Commanders for the digitized battlefield. Work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This PE is managed by the U.S. Army Research Institute (ARI) for the Behavioral and Social Sciences. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603007A - Manpower, Personnel and Training Advanced Technolo

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	3093	3527	8391	9698
Current Budget (FY 2004/2005 PB)	3077	7663	4931	7158
Total Adjustments	-16	4136	-3460	-2540
Congressional program reductions				
Congressional rescissions		-476		
Congressional increases		4800		
Reprogrammings	-4	-44		
SBIR/STTR Transfer	-12	-144		
Adjustments to Budget Years			-3460	-2540

Change Summary Explanation:

Significant Adjustments:

FY04 and FY05 funds realigned to higher priority requirements.

FY03 Congressional Adds:

(\$1400) Aircrew Coordination Training, Project 792; (\$3400) Army Training Support Center Education Training, Project 79A.

Projects with no R-2A:

Army Training Support Center Education Training, Project 79A, (\$3241): The purpose of this one year Congressional Add is to develop enhanced training technologies for use at Army Training Support Centers. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603007A - Manpower, Personnel and Training Advanced Technolo					PROJECT 792			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
792 PERSONNEL PERFORMANCE & TRAINING	3077	4422	4931	7158	6854	7033	7095	7193	

A. Mission Description and Budget Item Justification: The objective of this program is to develop and demonstrate advanced technologies to enhance performance to ensure that the "human component" of warfighting keeps pace with the transformations in systems, weapons, equipment, and requirements to meet the goals of the Objective Force. A key goal of this program is the reduction of training and other personnel costs through the development of more effective training strategies that optimize the advantages of live, virtual, and constructive simulations. Advanced technology development efforts include designing new ways to efficiently develop collective training methods and materials; developing and demonstrating training methods and programs that improve mission performance; devising strategies to use distributed training technologies to conduct multi-site training, assessment, and feedback; and evaluating the effectiveness of compressed gunnery training strategies for the Reserve Component. This program also develops leader development tools that capitalize on the various synthetic environments, game technologies, and delivery media (web, PDA, etc), that facilitate the advancement of leader knowledge, skills, and abilities (KSAs), and that can provide "experiences" to leaders earlier in their career development cycle. This program will develop self-development tools that do not currently exist that enable leaders to take full advantage of their schoolhouse experiences, that develop cognitive flexibility, and that accelerate the preparation of leaders for their next level of assignment; and will design innovative methods and technologies to improve leader decision-making, develop effective leaders for small team operations, and prepare Battle Commanders to operate within the evolving technological complexity envisioned for Objective Force operations. Work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This PE is managed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). The PE contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

This program does not contain Defense Emergency Response Funds (DERF).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

**0603007A - Manpower, Personnel and Training
Advanced Technolo**

PROJECT

792

Accomplishments/Planned Program

Training: In FY02, (1) evaluated new methods for more effective use of the Internet as a training delivery mode; (2) evaluated current training approaches for their relevance to training soldiers on the projected requirements for future operations; and (3) completed development and evaluation of new simulator technologies for training aircrew coordination. In FY03, generate guidelines and techniques for enhanced use of Web-based methods for individual and small group instruction; evaluate existing training techniques and tools for training unit-of-action level forces using virtual simulation experiments; and investigate the amount of simulator training needed to reach proficiency for live-fire qualification on small arms. In FY04, determine the best combination of simulator and live-fire training to maximize small arms marksmanship proficiency; develop prototype training support packages and conduct trial implementations to expand/refine the C4ISR training techniques and collective performance measurement approaches; and conduct research on the best use of on-line peer tutoring for enhancing digital skills. In FY05, conduct research on on-line game collaborations for advanced individual instruction; develop prototype tools to manage and adapt training for multiple unit requirements, delivery platforms, and systems.

FY 2002

FY 2003

FY 2004

FY 2005

2236

1914

2308

1916

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603007A - Manpower, Personnel and Training Advanced Technolo	PROJECT 792
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	FY 2002	FY 2003	FY 2004	FY 2005
<u>Accomplishments/Planned Program (continued)</u> Leader Development and Personnel Performance: In FY02, (1) identified the coaching and mentoring strategies used by effective leaders in developing cohesive teams; developed an Internet information resource on Active Component (AC) and Reserve Component (RC) operational and cultural differences to assist leaders with combining AC/RC soldiers into effective teams; and conducted the annual assessment of the Army command climate. In FY03, will develop and pre-test scenarios and role plays designed to help leaders train and develop team members and assess team performance. In FY04, will develop and evaluate an interactive simulation tool for developing versatile thinking in battle commanders and develop realistic Objective Force scenarios for facilitating the development of leader knowledge, skills, and abilities (KSAs); develop mentoring programs or tools that help mid-level unit leaders train and assess leadership skills and adaptability in their subordinates; and investigate tools and methods for leaders to use to improve unit climate and teamwork. In FY05, explore existing game and virtual strategies and technologies for their applicability and effectiveness in leader development and training; investigate methods to improve automation of real-life behaviors of a mentor/coach to increase individualization and remediation and to provide realistic interactions in synthetic environments; explore methods of automating assessment measures to determine the degree to which actual learning has occurred; and determine the most effective methods for leaders to use that will allow them to establish and maintain a positive unit climate and develop unit cohesion in times of personnel turbulence, stress, and changing operational requirements.	841	1108	2623	5242
Army Aircrew Coordination Training: The objective of this one-year Congressional Add is to complete the development of enhanced training and skill sustainment tools, both Web and simulation-based, for enhancing aircrew coordination training. No additional funding is required to complete this project.	0	1400	0	0
Totals	3077	4422	4931	7158

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	0	26931	40347	41982	47495	49948	42687	45166
TR1 TAC C4 TECHNOLOGY INT	0	14129	12407	17907	23032	25330	15904	16264
TR2 DIGITAL BATTLEFLD COMM	0	12802	27940	24075	24463	24618	26783	28902

A. Mission Description and Budget Item Justification: An integrated, seamless, mobile network is absolutely critical to enable Army transformation to the Objective Force. The goal of this program element (PE) is to provide the Army's Objective Force with a secure, mobile, wireless network that operates in diverse and complex terrain all the time, in all environments. Technologies will be matured in this PE to address this challenge with distributed, mobile, secure, self-organizing communications networks. Network access, service and speed of delivery are utterly essential. It will demonstrate the capability to seamlessly integrate communications technologies across all network tiers, ranging from unattended networks and sensors, through maneuver elements and airborne/space assets. External communication technologies will be investigated and leveraged, wherever possible. Technology options will be combined in a series of biannual Command, Control, Communications, and Computers Intelligence, Surveillance and Reconnaissance (C4ISR) On-The-Move (OTM) demonstrations to measure the battlefield effectiveness for Future Combat Systems (FCS) and the Objective Force. This PE also provides: protection technologies for tactical wireless networked networks against modern network attacks; smart networking technologies to network and control unmanned networks/sensors anywhere on the battlefield; enabling timely sensor-decider-engagement linkage to defeat critical targets; advanced antenna technologies for greater communications mobility, range and throughput; and automated network management aids. Several tasks are conducted in conjunction with the Defense Advanced Research Projects Agency (DARPA) and the other Services. Adaptive Joint C4ISR Node (AJCN) Advanced Concept Technology Demonstrations (ACTD) makes significant contribution to this programs 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.

The cited work is consistent with the Army Science and Technology Master Plan and the Army Modernization Plan. Work in this program element is related to, and fully coordinated with, efforts in PE 0602782A (Command, Control and Communications Technology), PE 0203740A (Maneuver Control Network), PE 0203726A (Advanced Field Artillery Tactical Data Network), PE 0602783A (Computer and Software Technology), PE 0602702E (Tactical Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), and PE 0603789F (C3I Technology Development). The PE contains no duplication with any effort within the Military Departments. This is not a new effort. Work was previously performed under PE 0603006A. Work is performed by the US Army Communications-Electronics Command, Fort Monmouth, NJ. This program supports the Objective Force transition path of the Army Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603008A - Electronic Warfare Advanced Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	0	28254	21729	20689
Current Budget (FY 2004/2005 PB)	0	26931	40347	41982
Total Adjustments	0	-1323	18618	21293
Congressional program reductions				
Congressional rescissions		-393		
Congressional increases				
Reprogrammings		-154		
SBIR/STTR Transfer		-776		
Adjustments to Budget Years			18618	21293

Change Summary Explanation: Funding - FY 2004/2005: Funds increased to support the AJCN ACTD and the Battle Command OTM Demos.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology					PROJECT TR1			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
TR1 TAC C4 TECHNOLOGY INT	0	14129	12407	17907	23032	25330	15904	16264	

A. Mission Description and Budget Item Justification: Networked communications is one of the major enablers of FCS and the Objective Force. This project matures key communications, mobile networking, and information assurance technology for the Dismounted Soldier, Future Combat Networks (FCS) and the Objective Force. The project enables the commanders and individual soldiers to survive and fight by providing secure, reliable, mobile communications network solutions that function in complex and diverse terrain. The majority of this project concentrates on the Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) ATD, a digital networking communication capability for the mounted and dismounted soldiers, and Information Assurance for Tactical Wireless Networks. MOSAIC is the cornerstone ATD that enables battle command mobility through mobile networking and bandwidth management. It matures and demonstrates the core self-organizing, ad hoc, mobile network technologies. It will use an open architecture approach to enable integration of other capabilities and technologies. Other programs that will be integrated into or leverage MOSAIC include On-The-Move (OTM) SATCOM, Advanced Antennas. OTM SATCOM enables mobile satellite communications through the application of blockage mitigation algorithms, thus enabling a robust reachback capability and a reduced in theatre footprint. 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 DARPA Small Unit Operations Situation Awareness Network (SUO SAS) communications technology will be leveraged and matured to provide a JTRS Compliant soldier radio. This effort will address the size, weight and power issues for the dismounted soldier. The Tactical Wireless Network Assurance program provides network protection for mobile wireless ad hoc networks and provides safeguards against modern network attacks. DARPA, ARL, and other Service technologies will be leveraged to provide solutions. 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. Management of these critical security components will be provided by the Network Security Agency that will demonstrate centralized remote control and visualization of network security health.

These communications solutions are absolutely essential to enable mission planning and battlefield decision making, execution and targeting. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology	PROJECT TR1
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>MOSAIC ATD –In FY03, conduct laboratory demonstration of the integration of the bandwidth adapting protocols, voice over Internet Protocol (IP), IP Quality of Service (QoS), mobile networking protocols and communications technologies. Enhance and modify MOSAIC communications and mobile ad-hoc networking protocols to support self organized wireless 15-20 node cluster with QoS (specified by latency, delayed jitter, and bit error rate). Integrate and evaluate enhanced mobile networking protocols and end-to-end quality of service mechanisms in a laboratory/field environment. Demonstrate robust wireless network access controls and detection techniques with validation on three mobile nodes to mitigate wireless intrusions and detect attacks close to 60% of the time. In FY04, demonstrate ad hoc mobility, reduced network initialization and recovery time, 15-20 node wireless OTM network with 56kbps-15Mbps. Perform integration of all MOSAIC networking and QoS technologies. Model and demonstrate the integrated network with an airborne node, space based assets, and terrestrial networks. In FY05, demonstrate 3-dimensional integrated seamless airborne network architecture to include airborne relays and satellite communications.</p> <p>Work in FY02 performed under PE 0603006A.</p>	0	10379	7707	3562
<p>Soldier/Squad-Level Communications: In FY04, leverage DARPA SUO SAS technology and reduce size, weight and power for OFW communications to a two-circuit card assembly configuration. Perform laboratory test and functional design verification. Produce network-on-chip design of a dual channel modem. In FY05, mature a re-programmable ASIC (Network-on-a-Chip) implementation for modem and networking processor components, and integrate in laboratory brassboard environment to demonstrate size, weight, and power consumption reduction for Objective Force Warrior communications.</p>	0	0	1500	8550
<p>OTM SATCOM: In FY03, mature and demonstrate Wideband OTM blockage mitigation protocol, integrate blockage mitigation algorithms and demonstrate them on CECOM/Space and Naval Warfare Systems Command (SPAWAR) Ka-band OTM Terminal. In FY04, integrate Wideband OTM capability into the FY04 MOSAIC ATD demonstration, mature and demonstrate MILSTAR OTM blockage mitigation approach for networks of MILSTAR terminals.</p>	0	2861	2200	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology	PROJECT TR1
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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Advanced Antennas - In FY03, mature technologies that will reduce the number of antennas and the visual signature for a ground vehicular Joint Tactical Radio Network Multiband OTM antenna covering the 30 to 2000 MHz frequency band. FY04 - For reconfigurable VHF, demonstrate reduction in Cosite interference and reduce three beam phased array receive antenna signature. In FY05, perform technical evaluation and integration for: (1) Multibeam Phased Array antenna technologies, maintain simultaneous multibeam OTM links over rolling terrain; (2) multiband antennas for rotary wing platforms, reduce range degradation due to cosite interference and platform interactions; (3) body borne helmet and vest antennas (at a 1 to 5 Km range) and perform RF assessment to ensure integration of environmental/ radiation safety; (4) Multiband reconfigurable band switched antenna technologies, tuned IAW JTRS interface operating between 30-450 MHz with reduction in cosite interference; (5) Low Profile antennas on ground and rotary wing platforms with reduced visual signature at 300 ft. Enhance and modify the modeling algorithms for Advanced Antennas to assess the Reconfigurable Band Switched antenna performance and provide communications visualization aids.	0	889	1000	3000
Tactical Wireless Network Assurance (TWNA) - In FY05, mature and test advanced network assurance via Tactical Public Key Infrastructure (PKI) on dynamic wireless ad hoc networks. Expand wireless intrusion detection to detect cyber attacks against distributed mobile hosts and networks that detect attacks that exploit mobile wireless protocols more than 60% of the time. Mature and test database access control and authentication of mobile data elements which restrict unauthorized modification to mobile code. Mature and perform laboratory testing of adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time.	0	0	0	2795
Totals	0	14129	12407	17907

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology					PROJECT TR2			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
TR2 DIGITAL BATTLEFLD COMM	0	12802	27940	24075	24463	24618	26783	28902	

A. Mission Description and Budget Item Justification: This project matures and demonstrates the warfighting value of an integrated C4ISR On-The-Move (OTM)(sensor to shooter) capability for Future Combat Systems (FCS) and the Objective Force. It makes a major contribution to improving the ability of the Army to survive and fight by providing the ability to move large amounts of data over extended ranges with minimal infrastructure, and tying in networks of unattended sensor fields. The efforts here concentrate on two major themes: The first theme, accomplished through the C4ISR OTM demo, provides 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. The second theme is to 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. The second theme is accomplished through three key programs: 1) Adaptive Joint C4ISR Node (AJCN) ACTD for mobile airborne communication nodes; 2) Network Sensors for the Objective force (NSfOF) Communications solution, enabling adaptable, self healing, low power, integrated communication nodes for unmanned sensor networks and 3) Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC), providing mobile protocols and seamless handoff (quality of service addressed in TR-1) capabilities to ensure the right information at the right time at the right place. The C4ISR OTM Demo provides early and continuing demonstrations of enhanced survivability and lethality for the FCS platforms through the effective employment of an integrated C4ISR On-the-Move ATD supported by ISR assets, manned and unmanned sensor networks, and networked fires. It leverages and integrates a variety of S&T, PM, and DARPA technology programs into a cohesive, integrated C4ISR network of networks that will provide decision makers a ‘view of the Future’ for Objective Force C4ISR mobility and an evolutionary view of integrated C4ISR functionality and its impact on Battlefield Effects. AJCN ACTD makes a significant contribution to providing assured communications for UoA. It provides 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. AJCN also has the capability to perform signals intelligence, information warfare and electronic attack missions simultaneously. AJCN matures technology developed under the DARPA Adaptive C4ISR Node program and leverages Joint Service funds from OSD, DARPA and the Air Force. AJCN starts in FY03 with Army contributions commencing in FY04. The AJCN will host communications waveforms (JTRS compliant) for extended range voice and data and enable interoperation between different types of radio platforms. It also enables data to be relayed between deployed manned/unmanned sensors and decision makers. The NSfOF Communications improves survivability by networking unattended sensors for real time local situation awareness and targeting. Several efforts will be leveraged to enable efficient routing and low power ad-hoc communications for the sensor suite, including the DARPA Small Unit Operations (SUO) and Sensor Information Technology (SensIT) programs as well as technologies developed by the Army Research Laboratory (ARL).The MOSAIC ATD facilitates battle command mobility, by providing multiple wireless solutions and seamless handoff to different networks for user flexibility in varied terrain over wide areas with improved network robustness. This program supports the Objective Force transition path of the TCP. No Defense Emergency Response Funds (DERF) were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology	PROJECT TR2
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>C4ISR OTM Demonstration - In FY03, conduct a series of technology evaluations to demonstrate the ability to do command and control for the Future Combat Networks (FCS) and the Objective Force (OF). Efforts include: modeling and simulation of sensors, networks, and command and control capabilities, to reduce costs of demo, in conjunction with the FCS Lead Network Integrator (LSI) contractor, TRADOC Battlelabs, and RDECs. Demonstrations of communications, ISR, and Command and Control FCS capabilities in an operational environment to demonstrate technology for FCS. Demonstration of battlefield effects (metal on target) enabled by integrated C4ISR. Generation of technical data to the FCS LSI in support of specification development. In FY04, perform a series of increasingly robust and expanded technical evaluations in support of FCS and OF acquisitions to demonstrate: increased maturity of integrated FCS C4ISR technologies in a more rugged operational environment, additional FCS capabilities, assess their maturity level, and collect performance data, modeling and simulation in support of field evaluations in conjunction with the TRADOC Unit of Action Battlelab's Simulation Center. In FY05, evaluate emerging FCS C4ISR architectures in conjunction with the LSI, UofA Battlelab and other RDEC's emphasizing the impact of technologies' contribution to user development of tactics, techniques and procedures (TTP's) for the Objective Force: integration of C4ISR networks into a network centric capability and evaluate the impact on battlefield effects. Impact of evolving software (S/W) defined radios and waveforms on C4ISR FCS networks to assess overall network performance in conjunction with C2, ISR and battlefield effects networks.</p>	0	7592	11789	12948

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT			
3 - Advanced technology development	0603008A - Electronic Warfare Advanced Technology	TR2			
<u>Accomplishments/Planned Program (continued)</u>		<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
AJCN ATCD – In FY04, design and integrate a multifunction aerial payload capability (increase data throughput from 288 to 900 kbps with range extension form 20 to 30 km) that provides integrated communications relay, signals intelligence, electronic warfare and information operations capabilities. Perform modeling and simulation of payload performance to mitigate risk in development. Integrate MOSAIC ATD networking communications capabilities so that range extension and continuous coverage between disparate units can be achieved. Host software defined radio (JTRS Compatible) waveforms, demonstrating voice and data interoperation between different types of radio platforms (from 3 to 9 waveforms). Enable data to be relayed between deployed manned/unmanned sensors (to include networked fires) and the users of that data. Integrate capability into both Army (2 Hunter with payload of 200lbs or less) and Air Force (2 RC-135) platforms to demonstrate scalability of capability. In FY05, Begin to conduct interim and follow-on joint military demonstration and user assessment of technology. Build and integrate ‘drop in upgrades’ as required. Conduct technical assessment to verify metrics are met and participate in Joint Force command exercises to demonstrate the capability on the operational platforms in the field environment.	0	0	9824	6866	
MOSAIC ATD and NSfOF Comms – MOSAIC ATD consists of 2 projects in this PE. In FY03, integrate and demonstrate automated network management technologies to provide dynamic network control and to minimize manpower. Apply technologies to on-the-move satellite communications and demonstrate integrated capability, mature low cost, JTRS software compliant architecture (SCA) compatible sensor communications breadboard models. In FY 04, demonstrate 50 mobile node and heterogeneous quality of service for FCS Communications, demonstrate 20 node (scalable to 100 node thru simulation) robust, self-healing, jam-resistant, LPI/LPD, energy -efficient (less than 500 mW) networking protocols for internode UGS communications with range of 200m and sensor to gateway connectivity to 3km. In FY 05, integrate and test a 50-node network with advanced sensors providing situational awareness to demonstrate communications range 200-400m and sensor connectivity of 3-10km.	0	5210	6327	4261	
Totals		0	12802	27940	24075

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	0	0	18649	20379	23099	23436	23618	23653
S28 INSTITUTE FOR CREATIVE TECHNOLOGY (ICT)-ATD	0	0	491	1668	5294	5291	5299	5296
S29 MODELING & SIMULATION - ATD	0	0	4396	4971	4079	4429	4581	4627
S30 JOINT VIRTUAL BATTLESPACE	0	0	6881	6870	6863	6858	6869	6865
S31 RDEC FEDERATION	0	0	6881	6870	6863	6858	6869	6865

A. Mission Description and Budget Item Justification: This program element demonstrates advanced technology for the next generation training and simulation systems of the Objective Force (OF). Technology demonstration is focused in four major areas. First, the Immersive Training Demonstrations project incorporates advanced modeling and simulation (M&S) and training and leader development technology into training demonstrations that have an emphasis on urban operations. Second, the Modeling & Simulation project will demonstrate a framework for future embedded training and simulation systems for the Future Combat Systems (FCS), the dismounted soldier, and the OF. Third, the Joint Virtual Battlespace (JVB) project develops and demonstrates the overarching M&S architecture that facilitates force-on-force modeling, supports the play of systems models, provides access to measures of effectiveness, and contributes to and works within the total OF. Fourth, the Research Development and Engineering Command (RDEC) Federation project will provide operational instances of interoperable component engineering-level simulations and models that conform to the JVB architecture specification to support and augment testing and training of the OF. Work is performed by the Provisional Research Development and Engineering Command (RDE Command), and by the Joint Precision Strike Demonstration (JPSD) project office of the Program Executive Office for Intelligence, Electronic Warfare & Surveillance (PEO IEW&S). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work in this program element is related to and fully coordinated with efforts in PE 0603238A, Project 177 (JT ALS PS DEMO); PE 0602308A, Project C90 (Advanced Distributed Simulation); PE 0602308A, Project D02 (Modeling and Simulation for Training and Design); PE0603001A, Project 545 (Force Projection Logistics); and PE0601104A, Project J08 (Institute for Creative Technology). This is a new PE established to transition maturing technology from PE0601104A, Project J08 (Institute for Creative Technology); PE 0602308A, Project C90 (Advanced Distributed Simulation); and PE 0602308A, Project D02 (Modeling and Simulation for Training and Design) into demonstration efforts. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603015A - Next Generation Training & Simulation Systems

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	0	0	0	0
Current Budget (FY 2004/2005 PB)	0	0	18649	20379
Total Adjustments	0	0	18649	20379
Congressional program reductions				
Congressional rescissions				
Congressional increases				
Reprogrammings				
SBIR/STTR Transfer				
Adjustments to Budget Years			18649	20379

Significant Changes:

FY04 - Funds increased to support Next Generation Training & Simulation Systems through investments in Immersive Training Demonstrations; Modeling and Simulation; JVB and RDEC Federation efforts by moving funds from modeling and simulation related efforts that were previously funded in several different PEs.

FY05- Funds increased to support Next Generation Training & Simulation Systems through investments in Immersive Training Demonstrations; Modeling and Simulation; JVB and RDEC Federation efforts by moving funds from modeling and simulation related efforts that were previously funded in several different PEs.

Project S30 was previously funded in PE 0603238, Project 177 (JT ALS PS Demo) in FY 03. Funding was added to accelerate and expand JVB capabilities to support FCS and OF decision making.

Project S31 was previously funded in PE 0602308A, Project C90 (Advanced Distributed Simulation) and PE0603001A, Project 545 (Force Projection Logistics) in FY 03. Funding was added to accelerate and expand RDEC Federation capabilities to support FCS and OF decision making.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems	PROJECT S28			
<u>Accomplishments/Planned Program</u> In FY 04, integrate immersive evaluation techniques into a training and leader development advanced technology demonstration within the OneSAF program. Demonstrations will incorporate a train-alone capability by incorporating advanced artificial intelligence techniques for after action review. In FY 05, use immersive environments developed for training and simulation systems to facilitate the integration of new algorithms and techniques into the after action review processes to permit self-assessment of mission accomplishment. Demonstrations will include a prototypical highly immersive multi-sensory environment that provides mixed reality (real and synthetic) objects for training and mission rehearsal.	FY 2002 0	FY 2003 0	FY 2004 491	FY 2005 1668	
Totals	0	0	491	1668	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems	PROJECT S29						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
S29 MODELING & SIMULATION - ATD	0	0	4396	4971	4079	4429	4581	4627

A. Mission Description and Budget Item Justification: This project will mature and demonstrate affordable next generation training and simulation systems that focus on virtual threats, asymmetric warfare, network-centric operations, and embedding training capabilities and technologies into operational go-to-war FCS and Objective Force Warrior (OFW) 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 homestation or deployed to remote locations worldwide with the ability to use those systems as training and mission rehearsal tools. 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 (Immersive Training Demonstrations) of this PE 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 operation; mission planning and rehearsal; command, control, and maneuver; C4ISR network analysis to support distributed simulations; and vehicle system interface requirements. This project was set up to transition basic and applied research from PE 0602308A, Project C90 (Advanced Distributed Simulation). Work is performed by the Provisional RDE Command. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems	PROJECT S29
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
In FY 04, integrate training hardware/software prototype with TARDEC's VETRONICS Technology Integration vehicle to provide a test of the system in a realistic environment and identify issue related to impact to tactical operation systems. Conduct a Mission Rehearsal experiment on a live surrogate vehicle using embedded simulation. Conduct a collective exercise with live and virtual training systems demonstrating robotics asset control training using appropriate resolution models that provide increased mission effectiveness of the embedded Combined Arms Team Trainers for FCS. Develop and experiment with simulations of C4ISR networks that will accommodate both operational and training network traffic to permitting deployed Combined Arms Team Training using embedded simulation environments. Initiate integration of mounted and dismounted soldier embedded training systems to address how individual soldiers, vehicle crews and small units will train, rehearse, and fight together. In FY 05, conduct experiments with mounted and dismounted embedded simulation systems to demonstrate the connectivity between the FCS and the OFW system. Demonstrate an embedded intelligent tutoring capability to provide training assessment and feedback to individual crew members based on training task, conditions, and standards for embedded training systems. Demonstrate prototype embedded instrumentation system addressing requirements for diagnostics, prognostics, testing and training maximizing the commonality of the individual system requirements.	0	0	4396	4971
Totals	0	0	4396	4971

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems					PROJECT S30			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
S30 JOINT VIRTUAL BATTLESPACE	0	0	6881	6870	6863	6858	6869	6865	

A. Mission Description and Budget Item Justification: In combination, Projects S30 (Joint Virtual Battlespace) and S31 (RDEC Federation) will provide the documented foundation for an integrated modeling and simulation architecture and reference implementation. This will allow each organization to be responsible for providing the data, models, and simulations that represent its functionality. This project provides the simulation architecture component of a robust, analytical and experimental M&S capability to study the key characteristics of network-centric warfighting systems and enable the evaluation of FCS, OF, and Joint Forces concepts. The architectural concept will include standardized component interfaces that separate warfighting platforms from battlefield issues such as command and control structures, environment (weather, terrain), and battlefield emissions (propagation, sensing). The architecture developed in this Project will integrate the “best of breed” engineering-level component models from the Army’s Provisional RDE Command that are developed in Project S31 (RDEC Federation) of this PE. The resulting M&S capability that combines this Project’s architectural component with the component models in Project S31 will provide the user with a tailorable, scalable system that addresses both human and hardware in the loop force-on-force scenarios. The resulting M&S capability will also serve as an integral part of a future persistent Army Collaborative Environment under the auspices of the Simulation and Modeling for Acquisition, Requirements and Training (SMART) initiative. In FY 03 this effort was funded in PE 0603238, Project 177 (JT ALS PS Demo). Work is performed by the JPSD project office of the PEO IEW&S. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems	PROJECT S30
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
In FY 04, enhance the JVB Architecture through the integration of lethality, survivability, and environment servers and the enhancement of the sensors and human factors models. Update and enhance the command, control, and communications grid of the JVB architecture. Develop enhanced tools for component technology and system of systems design trade-offs. Integrate commercial prototypes and conduct operational analysis of contractor provided concepts in support of OF trade offs. Document the newly developed and enhanced run time interfaces, federated object models and application program interfaces. In FY 05, integrate fusion, damage, and sustainment servers. Update the lethality, survivability, and environment servers. Conduct Joint experiment for tactics, techniques, and procedures and concept of operations for the equivalent of a dismounted infantry company. Build, publish, and distribute government owned version 1.0 software of the JVB architecture. Document the newly developed and enhanced run time interfaces, federated object models, and application program interfaces.	0	0	6881	6870
Totals	0	0	6881	6870

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems	PROJECT S31						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
S31 RDEC FEDERATION	0	0	6881	6870	6863	6858	6869	6865

A. Mission Description and Budget Item Justification: In combination, Projects S30 (Joint Virtual Battlespace) and S31 (RDEC Federation) will provide the documented foundation for an integrated modeling and simulation architecture and reference implementation. This will allow each organization to be responsible for providing the data, models, and simulations that represent its functionality. This project provides engineering-level simulation model components of a robust, analytical and experimental M&S capability to study the key characteristics of network-centric warfighting systems and enable the evaluation of FCS, OF, and Joint Forces concepts. The architectural concept will include standardized component interfaces that separate warfighting platforms from battlefield issues such as command and control structures, environment (weather, terrain), and battlefield emissions (propagation, sensing). This project will provide the “best of breed” engineering-level component models from the Army’s Provisional RDE Command that will be integrated into the simulation architecture developed in Project S30 (Joint Virtual Battlespace) of this PE. The resulting M&S capability that combines this Project’s component simulation models with the architecture developed in Project S30 will provide the user with a tailorable, scalable system that addresses both human and hardware in the loop force-on-force scenarios. The resulting M&S capability will also serve as an integral part of a future persistent Army Collaborative Environment under the auspices of the Simulation and Modeling for Acquisition, Requirements and Training (SMART) initiative. In FY 03 this effort was funded in PE 0602308A, Project C90 (Advanced Distributed Simulation) and PE0603001A, Project 545 (Force Projection Logistics). Work is performed by the Provisional RDE Command. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603015A - Next Generation Training & Simulation Systems	PROJECT S31
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
In FY 04, Release Reference Implementation v0.5 that will comply with JVB architectural standards. Develop and modify computer software and procure the hardware necessary to connect each site in a secure distributed network. Conduct series of experiments exploring component fidelity. Further develop network sensitivity, scalability, and update environment. Continue development of methodologies to incorporate asymmetric warfare. Enhance human performance modeling to include command control information operations and individual/crew models. Include additional component M&S to include logistics resupply, ATEC, TRADOC, and other Services. In FY 05, further develop server fidelity, network infrastructure, and agent based technology. Validate the RDEC Federation environment and update as needed. Improve human performance modeling and continue component integration. Improve network sensitivity and scalability to implement Reference Implementation v1.0.	0	0	6881	6870
Totals	0	0	6881	6870

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603103A - Explosive Demilitarization Technology						PROJECT D51	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
D51 EXPLOSIVES DEMIL TECH	0	0	9349	9860	10030	10213	10259	10469

A. Mission Description and Budget Item Justification: The Explosive Demilitarization Technology Program is a cooperative interservice, interagency effort focused as the sole Department of Defense (DoD) program dedicated to the development of safe, efficient and environmentally acceptable processes for the resource recovery and recycling (R3) or disposition of strategic, tactical, and conventional munitions including explosives, and rocket motors. Efforts in this program emphasize environmentally compliant technologies to enhance existing methods for munitions R3 and treatment and seeks alternatives over that of open burning/open detonation (OB/OD). There are currently over 500,000 tons of these materials requiring disposition with a forecast of over 1,450,000 tons to flow through the stockpile by 2006. The effort employs the highly developed 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 Joint Ordnance Commanders Demilitarization Subgroup and seeks to leverage support from the Department's Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP), the Joint DoD/DOE Munitions Program, and complementary Service science and technology programs. Each project is required to include a federal laboratory sponsor and is provided peer review by the Joint Working Group. The Demilitarization Users Group is utilized to assess and review ongoing and emergent demilitarization requirements for use in planning future investments for this program. The program supports an annual Global Demilitarization Symposium, which focuses on technology transfer opportunities and the technical review and data evaluation from ongoing projects and advanced demonstrations. This program was established pursuant to Section 226 of the National Defense Authorization Act Fiscal Year 1996 (Public Law 104-106) and Section 227 of the National Defense Authorization Act for Fiscal Year 1997 (Public Law 104-201). The program provides an annual report to the Congress, which provides a detailed plan update on technology investments, accomplishments, and future planned investment areas. The Explosive Demilitarization Technology Program was previously managed under PE 0603104D8Z; starting in FY04 it will be managed by the U.S. Army Armament Research, Development and Engineering Center at Picatinny Arsenal, NJ. The program element contains no duplication with any effort within the Military Departments. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

There are no Defense Emergency Response Funds provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603103A - Explosive Demilitarization Technology		D51	
<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Test Site Demonstration Program (TSDP): In FY04, the TSDP will complete efforts on field detonation operations. Data from previous tests will be used to conduct advanced open detonation experiments. Process efficiencies will be maximized and emissions will be minimized. Testing of the Contained Burn Chamber for tactical missiles will continue; optimization studies will be completed. Advanced Molten Salt Technology dem/val will continue. Development of an integrated Cryofracture/Plasma Arc process will continue; detailed design and equipment fabrication will be initiated. In FY05, Molten Salt Technology systems development and demonstration (SDD) will continue. For the integrated Cryofracture/Plasma Arc process, detailed design of will be completed and equipment fabrication will continue.	0	0	5049	5500
Advanced Removal/Conversion (AR/C): In FY04, microwave removal technology studies will be completed. Design of an inductively coupled pilot plant will be completed and fabrication of equipment will begin. Biodegradation studies on wastewater from waterjet and autoclave demil processes will continue. In FY05, equipment fabrication for the inductively coupled pilot plant will be completed and installation will begin. Wastewater biodegradation studies will be completed. Ultrasonic removal technology will be investigated.	0	0	900	1600
Advanced Automated Munitions Disassembly (AAMD): In FY04, AAMD efforts in the areas of robotic disassembly of projectiles and advanced water jet and laser cutting will continue. The robotic disassembly workcells developed for the ADAM projectile and the 8 inch RAP round will be demonstrated and validated. Design of workcells for other improved conventional munitions (ICMs) and cluster bomb units (CBUs) will get underway. In FY05, design of robotic workcell hardware for selected ICMs and CBUs will be completed and equipment fabrication will be initiated.	0	0	1500	2160
Liquid Ammonia Reduction (LIR) Pilot Process: In FY04, shake-down testing and SDD of the LIR pilot process for tactical missiles will be completed.	0	0	1000	0
Advanced Destruction Systems (ADS): In FY04, demonstration of enhanced rotary furnace for conventional munitions will be completed and optimization of the fixed detonation chamber prototype will be completed.	0	0	600	0
Development of Analytical Tools (AT) for optimization of demil processes: In FY04, AT development focusing on explosives and propellants will continue and development of Design for Demil ATs will be initiated. In FY05, expanded ATs for explosives and propellant evaluation will continue to be optimized for recovered items and Design for Demil AT tool development will continue.	0	0	100	600
Hot Gas Decontamination (HGD): In FY04, demonstration/validation of the HGD system will be completed.	0	0	200	0
Totals	0	0	9349	9860

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603103A - Explosive Demilitarization Technology

PROJECT
D51

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget	0	0	0	0
Current Budget (FY 2004/2005 PB)	0	0	9349	9860
Total Adjustments	0	0	9349	9860
Congressional program reductions				
Congressional rescissions				
Congressional increases				
Reprogrammings				
SBIR/STTR Transfer				
Adjustments to Budget Years			9349	9860

Significant Changes:

FY04/05: PE devolved from OSD to Army in FY04; funds development of processes for the resource recovery and recycling (R3) or disposition of strategic, tactical, and conventional munitions including explosives, and rocket motors.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603105A - MILITARY HIV RESEARCH						PROJECT H29	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H29 MED PROTECT AGNST HIV	5697	0	6733	6746	6956	7111	7121	7117

A. Mission Description and Budget Item Justification: This project supports the medical technology area of the Objective Force by conducting concept exploration of candidate vaccines to include safety and efficacy in model systems to prepare and conduct clinical studies. It funds Acquired Immune Deficiency Syndrome (AIDS) research to control the infection in military environments, protect the military blood supply, and protect military personnel from risks associated with infection. AIDS research is focused on the following areas: diagnosis, natural history, epidemiology, and vaccine development. Pre-clinical trials and phase 1, 2, and 3 clinical trials are performed as required for drug and vaccine licensure with US Food and Drug Administration. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

There are no Defense Emergency Response Funds provided to this program or project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603105A - MILITARY HIV RESEARCH

H29

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>FY02, continued to prepare for HIV vaccine testing in Africa by studying the different types of HIV present. Evaluated immune responses to HIV in individuals enrolled in HIV vaccine trials. Developed a candidate HIV-1 vaccine using a modified vaccinia viral backbone and performed pre-clinical evaluations. Continued development of vaccine test and evaluation field sites in East Africa and Cameroon. Continued surveillance for new and emerging HIV subtypes within Eastern Europe, Africa and the Middle East. FY03 HIV program transferred to the National Institutes of Health (NIH). FY04, HIV program was returned to the Army. Produce clinical-grade quantities of candidate vaccines against HIV subtypes D and A. Initiate phase 1 study of a candidate HIV vaccine(s) in East Africa and other new and improved HIV vaccine candidates. Identify appropriate populations for advanced development of selected candidate vaccines in East Africa. Establish diagnostic capabilities needed to differentiate vaccine-induced immune response from HIV infection in clinical trials. Improve tests needed to assess immune responses induced by HIV vaccines. Conduct pre-clinical studies of candidate HIV vaccines in animal models to determine safety and induction of responses before studies are begun in humans. Conduct a multi-center clinical study to investigate HIV drug resistance. Begin phase 2 clinical testing for selected HIV vaccine candidates for transition to advanced development by FY06. FY05, continue multi-year efforts from prior year.</p>	5697	0	6733	6746
Totals	5697	0	6733	6746

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603105A - MILITARY HIV RESEARCH

PROJECT
H29

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	5885	0	0	0
Current Budget (FY 2004/2005 PB)	5697	0	6733	6746
Total Adjustments	-188	0	6733	6746
Congressional program reductions				
Congressional rescissions				
Congressional increases				
Reprogrammings	-25			
SBIR/STTR Transfer	-163			
Adjustments to Budget Years			6733	6746

Change Summary Explanation: Funding – In FY 2003 program responsibility for management and oversight of HIV R&D efforts was transferred to the National Institutes of Health (NIH). In FY 2004 program was returned to the Army.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

**0603125A - Combating Terrorism, Technology Development
for**

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	0	41842	4916	3436	0	0	0	0
DF1 SURVIVABILITY & DENIAL	0	0	4916	3436	0	0	0	0
DF2 DETERRENCE, INDICATION & WARNINGS	0	33453	0	0	0	0	0	0
DF3 CONSEQUENCE MANAGEMENT & RECOVERY	0	1431	0	0	0	0	0	0
DF4 ATTRIBUTION & RETALIATION	0	6958	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this project is to mature and demonstrate advanced survivability engineering technologies against asymmetric threats. Also supports the Integrated Survivability transformational effort for the Objective Force. Base Camp Protection will demonstrate 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 Objective Force in low-intensity conflicts and peacekeeping operations. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan. The program element contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

\$41842 in Defense Emergency Response Funds were provided to this program element in FY03.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

**0603125A - Combating Terrorism, Technology Development
for**

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	0	0	0	0
Current Budget (FY 2004/2005 PB)	0	41842	4916	3436
Total Adjustments	0	41842	4916	3436
Congressional program reductions				
Congressional rescissions		-613		
Congressional increases		43900		
Reprogrammings		-240		
SBIR/STTR Transfer		-1205		
Adjustments to Budget Years			4916	3436

Change Summary Explanation: Funding - FY 2004/2005: Funds increased to support Base Camp Protection/Survivability efforts.

FY03 Congressional Adds:

DERF - Counter Terrorism (CT) Echelon Surveillance and Reconnaissance, Project DF2 (\$15000); DERF – Blue Force Awareness Suite, Project DF2 (\$10000); DERF – Universal Soldier Sensor, Project DF2 (\$8000); DERF – Multi-function Remote Unattended Ground Sensor, Project DF2 (\$1500); DERF – Remove Observation & Confirming Sensors, Project DF2 (\$600); DERF – Laser Induced Breakdown Spectroscopy, Project DF3 (\$1500); DERF – Language Translation, Project DF4 (\$7300).

Projects with no R2-As:

- (\$35100) Deterrence, Indications and Warning, Project DF2: The objective of this Defense Emergency Response Fund (DERF) project is to mature technologies needed to help prevent terrorist acts by facilitating the timely interdiction of terrorists, threat agents and/or devices, and early warning of impending attack to enable the implementation of protective countermeasures. Technologies funded include CT Echelon Surveillance and Reconnaissance (\$15000); Blue Force Awareness Suite (\$10000); Universal Soldier Sensor Urban/Cave Assault Kit (\$8000); Multi-function Remote Unattended Ground Sensor (\$1500); and Remove Observation and Confirming Sensors (\$600).

- (\$1500) Consequence Management and Recovery, Project DF3: The objective of this DERF project is to develop a briefcase-size detector capable of detecting and identifying explosives, chemical/biological agents, precursors, and materials potentially associated with terrorist activities. The system is based on Laser Induced Breakdown Spectroscopy.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

**0603125A - Combating Terrorism, Technology Development
for**

-\$7300 Attrition and Retaliation, Project DF4: The objective of this DERF project is to develop a Language Translation and support system that provides real-time access capability to language translations and associated automated resources in the field.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603125A - Combating Terrorism, Technology Development for				PROJECT DF1			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
DF1 SURVIVABILITY & DENIAL	0	0	4916	3436	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this project is to mature and demonstrate advanced survivability engineering technologies against asymmetric threats. Also supports the Integrated Survivability transformational effort for the Objective Force. Base Camp Protection will demonstrate 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 Objective Force in low-intensity conflicts and peacekeeping operations. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan. The program element contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to this project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Base Camp Protection/Survivability – In FY04, develop capability for base camp planning and layout, and develop base camp survivability measures for blast and ballistic protection suitable for use by Interim Stryker Brigades. In FY05, demonstrate initial integration of weapons effects data, survivability assessment procedures, and the Anti-Terrorist (AT) planning software for base camp planning and assessment. Demonstrate base camp survivability measures for blast and ballistic protection.	0	0	4916	3436
Totals	0	0	4916	3436

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603238A - Global Surveillance/Air Defense/Precision Strike T					PROJECT 177			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
177 JT ALS PS DEMO	34963	29788	12660	8833	12609	12939	13246	13549	

A. Mission Description and Budget Item Justification: Joint Precision Strike Demonstration's (JPSD) mission is to integrate and demonstrate innovative futuristic Operational Concepts and Tactics Techniques and Procedures (TTPs) with emerging technologies to significantly improve OSD/Joint Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) capabilities. JPSD horizontally integrates state of the art software applications and tools across the spectrum of C4ISR to optimize sensor to shooter operations and solve critical joint problems. The Integration and Evaluation Center (IEC) combines live and simulated entities into a Joint Virtual Battlespace (JVB) for conducting studies and demonstrations for measuring and evaluating systems designs and concepts for use in joint C4ISR and system solutions. The IEC is the foundation for JPSD's Simulation Based Acquisition process and is the basis for developing the JVB. JVB facilitates the assessments needed for smart and timely acquisition decisions on Future Combat System (FCS) and Objective Force (OF) while assessing the operational impact of concepts in a joint environment. JVB integrates existing OSD approved models and simulations in creating a joint battle space which is then used to evaluate and determine the best and most cost effective system-of-systems designs as compared to individual component systems solutions. No other tool is available in the Army to provide this operational, constructive and virtual, analysis support. JVB is the only Modeling & Simulation tool that measures the combat effectiveness of information and how it is used. The Theater Precision Strike Operations (TPSO) Advanced Concept Technology Demonstration (ACTD), by use of state of the art software applications/tools provides the Commander, Combined Forces Command (CFC), Korea with a significantly enhanced Theater-wide capability to plan, coordinate and conduct Counter fire, Precision Strike Engagements and Joint Battlespace Command and Control (C2). TPSO has also provided software applications for the worldwide Combatant Commanders and their component commanders to perform Near-Real-Time C2. These enhancements have been provided to CENTCOM, PACOM, SOCOM, EUCOM and JFCOM. The Joint Intelligence, Surveillance and Reconnaissance (JISR) ACTD implements a tactical networked sensor grid using internet web based technologies to horizontally integrate tactical and operational level ISR information from existing stove-piped legacy Service and joint C4ISR systems for CENTCOM (ARCENT and 1st Marine Expeditionary Force (MEF)). JISR also integrates nontraditional tactical sensors (i.e., FIREFINDER radar and unattended ground sensors) into an Intelligence, Sensor and Reconnaissance (ISR) picture which allows the Early Entry Force (EEF) Commander and his higher headquarters to access and geospatially visualize all available ISR information using any workstation equipped with a web browser. This capability will be integrated worldwide. The Joint Continuous Strike Environment (JCSE) ACTD provides the Combined/Joint Task Force (CJTF) with the capability to execute time critical targeting with four software modules (target prioritization; continuous weapons availability monitoring, optimized weapon-target pairing and dynamic airspace deconfliction). Key terrain elevation data is critical to Intelligence Preparation of the Battlefield (IPB), mission planning and rehearsal, and support to military operations. The JPSD is a member of the Program Executive Office, Intelligence, Electronic Warfare, and Sensors (PEOIEW&S), Fort Monmouth, NJ. These ACTD systems support the Objective Force transition path of the Transformation Campaign Plan (TCP).

Defense Emergency Relief Fund (DERF) funding of \$4.5M was provided for Automated Deep Operations Coordination System (ADOCS) capability in the TPSO ACTD for Counter-Terrorism to increase situational awareness.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603238A - Global Surveillance/Air Defense/Precision Strike T

PROJECT

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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>TPSO ACTD - FY02: Participated in Combined Forces Command (CFC) component warfighting exercises to significantly enhance their C2 architecture through Automated Deep Operations Coordination System (ADOCS). Supported major CFC exercises, provided refined, expanded, and enhanced ADOCS support to the CFC Combined Effects Synchronization Cell (CESC). Provided major support to Joint Exercises through ADOCS to include Millennium Challenge 02, Navy Fleet Battle Experiment-JULIET, and Air Force activities Joint Expeditionary Force Experiment (JEFX) and combined Air Operations Center-Experiments (CAOC-X). Conducted ADOCS rapid software prototyping operations at the JPSD IEC to support training, upgrades and field support to major field exercises (RSO&I, UFL 02, Lucky Sentinel, MC02, MEFEX, FBE-J, JEFX). Continued to transition and sustain ADOCS applications in CFC combat units and applications worldwide (use of over 2,000 applications in CENTCOM, EUCOM, PACOM, SOCOM and JFCOM). Provided ADOCS to US engaged forces in Kosovo and Afghanistan. Prepared final transition and sustainment plans to support the TPSO "Leave Behind" Systems including a Battlespace Visualization system in the CFC CESC; upgraded software applications; integrated training support packages for 230+ ADOCS.</p> <p>FY03: Participating and supporting major CFC exercises and component exercises to add ADOCS upgrades and new capabilities demonstrated in FY02 and planned for FY03. Conducting rapid ADOCS prototyping operations at the JPSD IEC to support training, upgrades and field support to major field exercises (RSO&I; UFL03, Lucky Sentinel, MC03, MEFEX, BFE-J, JEFX). Upgrading ADOCS worldwide with new capabilities based on critical CFC requirements (CENTCOM, EUCOM, SOCOM, PACOM and JFCOM). Executing transition and sustainment plans to support the TPSO "Leave Behind" systems during the final year of transition. Maturation of DII - COE Level Six compliant version of ADOCS.</p>	12269	9535	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT			
3 - Advanced technology development	0603238A - Global Surveillance/Air Defense/Precision Strike T	177			
<u>Accomplishments/Planned Program (continued)</u>		<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
<p>JISR ACTD - FY02: Upgraded the JISR prototype to accept more traditional sensor feeds and to more rapidly display ISR to the Commanders. Participated in Marine Expeditionary Force Exercises (MEFEX 02). Supported CENTCOM with JISR applications.</p> <p>FY03: Expand ISR observed capability through the JISR prototype. Continuing to refine and enhance JISR interfaces and other JISR applications and participate in Lucky Sentinel 03 and MEFEX 03.</p> <p>FY04: Mature JISR applications with other programs to include Tactical Exploitation Systems (TES), Joint Digital Fires Network and Distributed Common Ground System - Army (DCGS-A) to demonstrate JISR added value. Planning and executing military utility assessment with Joint Interoperability Test Center (JITC), Joint C4ISR Battle Center and warfighter assessments by CENTCOM and I MEF. Certify Defense Information Infrastructure/Common Operating Environment (DII/COE) compliance to authorities to include DISA. Initiate transition JISR ACTD applications to identified programs of record.</p> <p>FY05: Mature and validate the DII certification. Finalize transition of JISR applications to programs of record. Provide sustainment support.</p>		1650	4785	12660	8833
<p>JVB - FY02: Developed software to model command, control and communications in a virtual man-in-the-loop environment. Integrated Joint Force-on-Force models with component simulations in the JVB framework. Incorporated FCS contractor concepts/models in JVB. Provided data and results from TRAC Analysis of Alternatives (AoA) study to the analysis community to support operational evaluations. Integrated additional models from the Department of Energy and other government agencies. Supported TRAC AoA study with hardware, software and technical expertise. Developed and provided software infrastructure to support the FCS C4ISR Experiment at Ft. Knox and the FCS Lead System Integrator (LSI) Capstone Demonstration.</p> <p>FY03: Supporting FCS C4ISR Experiment at Ft. Knox in Dec 2003 and FCS LSI Capstone Demonstration in March 2003 (key events for FCS Milestone B Decision in FY 2003). Developing software to integrate contractor virtual prototypes and conducting operational analysis of contractor final concepts in support of FCS program decision. Integrating dynamic environment, NBC component simulations and CONOPS/tactics into the JVB framework. Integrating federates from the Research, Development and Engineering Center community. Starting in FY04, funding for this effort is provided in PE 0603015A, Project S30.</p>		20319	15468	0	0
<p>JCSE ACTD - FY02: Upgraded, integrated and transitioned Joint Continuous Strike Environment (JCSE) software applications into the Joint Targeting Toolbox (JTT) program of record.</p>		725	0	0	0
Totals		34963	29788	12660	8833

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
**0603238A - Global Surveillance/Air
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PROJECT
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<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	31986	31291	12930	12730
Current Budget (FY 2004/2005 PB)	34963	29788	12660	8833
Total Adjustments	2977	-1503	-270	-3897
Congressional program reductions				
Congressional rescissions		-487		
Congressional increases				
Reprogrammings	3857	-171		
SBIR/STTR Transfer	-880	-845		
Adjustments to Budget Years			-270	-3897

Change Summary Explanation: Funding - FY 2002: Funds reprogrammed to support the FCS C4ISR experiment at Ft. Knox. FY 2005 - Funds realigned to higher priority requirements.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603270A - EW TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	23537	18756	11273	9213	17448	18489	18744	18944
K12 AN/AVVR-1 LASER WARNING RECEIVERS	0	1906	0	0	0	0	0	0
K15 ADVANCED COMM ECM DEMO	6330	3134	4853	2764	8466	9335	9385	9368
K16 NON-COMMO ECM TECH DEM	7038	7617	6420	6449	8982	9154	9359	9576
K19 MULTIPLE INTEL REMOTED SENSOR SYSTEM - BLK 1	4413	6099	0	0	0	0	0	0
K20 SHORTSTOP	5756	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: Matures and demonstrates multi-intelligence remote sensor technologies and electronic warfare (EW) survivability systems to significantly enhance the Objective Force's survivability, lethality and ability to conduct offensive operations to win the information war. 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. The advanced communications Electronic Countermeasures (ECM) K15 project 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). The Non-communication ECM technology demonstration project (K16) 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. Technologies matured as part of this PE will be demonstrated in the integrated situation awareness (SA) and targeting advanced technology demonstration (ATD), and the integrated counter measures platform survivability effort. 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). This work is consistent with the Army Science and Technology Master Plan, and the Army Modernization Plan. The program element contains no duplication with any effort within the Military Department. Work is provided by the US Army Communications-Electronics Command, Fort Monmouth, NJ. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

There are no Defense Emergency Response Funds provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603270A - EW TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	24367	11600	10867	14556
Current Budget (FY 2004/2005 PB)	23537	18756	11273	9213
Total Adjustments	-830	7156	406	-5343
Congressional program reductions				
Congressional rescissions		-695		
Congressional increases		8400		
Reprogrammings	-232	-108		
SBIR/STTR Transfer	-598	-441		
Adjustments to Budget Years			406	-5343

Change Summary Explanation: Funding - FY 2004/2005: Funds realigned to higher priority requirements.

FY03 Congressional Adds:

(\$2000) AN/AWR-1 Laser Warning Receivers, Project K12; (\$6400), Multi-functional Intelligence & Remote Sensing System, Project K19.

Projects with no R-2A:

AN/AWR-1 Laser Warning Receivers, Project K12 (\$1972). The objective of this one year congressional add is to complete the qualification of the AN/VVR-3, procure prototype systems and perform a demonstration on a combat vehicle. Conduct an analysis of improvements to the AN/VVR-3 to determine the modifications necessary to update the system for future threats and to incorporate an Angle of Arrival module. No additional funding is required to complete this project.

Multi-functional Intelligence & Remote Sensing System, Project K19 (\$6310): The objective of this one-year congressional add is to: Investigate new power management techniques/algorithms for Multi-functional Intelligence Ground Sensors; Integrate advanced geo-physical and EO/IR sensors into the Block IA Silent Warrior ruggedized system; Investigate techniques for Low Probability of Intercept/Low Probability of Detection communications; Demonstrate Silent Warrior Block 1A systems to refine tactics, techniques and procedures. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603270A - EW TECHNOLOGY						PROJECT K15	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
K15 ADVANCED COMM ECM DEMO	6330	3134	4853	2764	8466	9335	9385	9368

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 Objective 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. The aim of the Warfighter Electronic Collection and Mapping program is to provide the warfighter at the unit level with the ability to locate enemy tactical radio RF emitters. Electronic Support for the Objective Force (OF) will provide lightweight, low cost UAV and Unattended Ground Sensors (UGS) Electronic Support Measures (ESM) to detect and locate modern signals of interest. The Joint Intelligence, Surveillance, and Reconnaissance (JISR) Advanced Concept Technology Demonstration (ACTD) provides the tools that allow the warfighter, at all echelons, a comprehensive near-real time view of ISR information based on both traditional and selected non-traditional sensors to enhance situation awareness. Information Operations for the OF 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 C2 Protect and Attack ATD demonstrated electronic attack products that have the ability to disrupt, deny, degrade, deceive or destroy computer networks, C2, and resident information/data. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

Accomplishments/Planned Program

	FY 2002	FY 2003	FY 2004	FY 2005
- Tactical C2 Protect ATD: In FY02, demonstrated the ability to protect the Army's tactical information systems by evaluating the effectiveness of attack against protection mechanisms in a laboratory demonstration. Numerous vulnerabilities of the tactical internet were uncovered in field tests. Remedial steps to prevent intrusion/unauthorized access were documented and passed on to PEO-C3-T for implementation.	1141	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603270A - EW TECHNOLOGY	PROJECT K15
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<u>Accomplishments/Planned Program (continued)</u>	FY 2002	FY 2003	FY 2004	FY 2005
- JISR ACTD: In FY02, demonstrated software for automated intelligence support system mission planning and military intelligence (MI) asset management tools. Completed antenna pattern test system mission planning. Demonstrated terrain-reasoning tools. In FY03, integrate advanced intelligence web applications into existing brigade intelligence systems to enhance situation awareness by ultimately increasing sensor feeds, timeliness, and number of users accessing shared data. Demonstrate initial operational capability and participate in two field exercises. Other work related to this project is performed under project K16.	2050	2431	0	0
- Warfighter Electronic Collection, Mapping, and Support for Objective Force: This effort matures and demonstrates technologies that enable tactical signal intercept and jamming. In FY02, completed design and fabrication of three hardware platforms for field test and evaluation of RF collection algorithm performance. In FY03, integrate warfighter RF collection system co-resident algorithms on Small Unit Operations (SUO) radio platform to enable SUO radios to perform RF collection. In FY04, provide advanced simulation capability of ESM sensors and integrate to the Mounted Maneuver Battlespace Lab at Ft. Knox to evaluate tactics and tactical internet throughput requirements to support networked, unattended radio frequency sensors for Future Combat Systems. In FY05, perform lab and field test for networked radio frequency (RF) Electronic Support Measure (ESM) sensor architecture for unmanned ground and air vehicle applications for Future Combat Systems. Integrate and demonstrate unattended ground and air RF ESM sensors with the network radio links matured by the Networked Sensors for the Objective Force (NSfOF) Advance Technology Demonstration program and other future combat system (FCS) efforts. Integrate software in model of Information Operations systems, test wired and wireless detection and recognition algorithms for correlation of virtual addresses and real locations. Other work related to this project is performed under project K16.	3139	703	4853	2764
-	0	0	0	0
Totals	6330	3134	4853	2764

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603270A - EW TECHNOLOGY					PROJECT K16			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
K16 NON-COMMO ECM TECH DEM	7038	7617	6420	6449	8982	9154	9359	9576	

A. Mission Description and Budget Item Justification: This project matures and demonstrates the Objective Force non-communication, multi-functional electronic warfare capability to enhance the survivability of ground combat vehicles and the dismounted forces. The vehicle survivability approach will provide detection avoidance through signature management and hit avoidance using warning receivers and 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 fuzed munitions. The ability to neutralize booby trap improvised explosive devices (IEDs) will be matured and demonstrated by embedding the maximum capability in projected FCS/Objective Force systems to minimize vehicle weight, cost, logistics and fielding. Additionally, this project will demonstrate EO technologies and countermeasures technologies against laser-aided and electro-optically directed gun or missile systems. This project also demonstrate 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 to support a "see first, understand first, act first, finish decisively" standard. The Warfighter Electronic Collection and Mapping (WECM) program provides the capability at the unit level to locate enemy tactical radio frequency (RF) emitters. This will employ non-traditional uses of software defined radios to perform tactical, short-range detection of threat emission. The Joint Intelligence, Surveillance, and Reconnaissance (JISR) ACTD will provide the tools that allow the warfighter, at all echelons, a comprehensive near-real time view of ISR information based on both traditional and selected non-traditional sensors to enhance situation awareness. This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603270A - EW TECHNOLOGY	PROJECT K16
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- This effort matures and demonstrates technologies that enhance system survivability. In FY02, integrated and evaluated integrated countermeasures capabilities in a ground vehicle. Field tested millimeter wave electronic countermeasures, live fire top attack fuze jamming, and deception of battlefield surveillance radars. In FY03, perform antitank guided missile (ATGM), surface-to-air missile and anti-aircraft artillery CM modeling and simulation. In FY04, integrate 2 color mid-IR ground vehicle missile warning sensors with IR jammers for use against ATGMs with RF counter reconnaissance deception and jammer subsystems for use against surveillance radars and top attack munitions. Mature and conduct lab test for detection, location, deception and countermeasure algorithms against enemy sensors and booby traps, for operation beyond the kill range of the munition, on a moving vehicle. In FY05, Conduct lab and field demos of IED neutralization techniques conducted beyond 1.5 times the kill range of the munition.</p>	1776	2637	6420	6449
<p>- This effort matures and demonstrates technologies that enable the networked information operations with joint intelligence, surveillance, reconnaissance, and intercept. In FY02, conducted distributed interactive simulation to evaluate feeds into the Joint Intelligence, Surveillance and Reconnaissance (JISR) Advanced Concept Technology Demonstrations (ACTD). In FY03, demonstrate in a field test, RF collection system on surrogate RF radio platform to detect and geolocate enemy's close battle, low power tactical communications. Demonstrate electronic mapping at vehicle, company and JISR levels. Demonstrate ability of radios to network and pass threat situation awareness information to Battle Command Brigade and Below and JISR in less than two minutes. Perform final experiment to demonstrate data correlation, cueing, complete mission planning, and analysis tools. Correlate imagery intelligence, human intelligence and signals intelligence into human centered decision making formats that can be quickly used at levels from combat vehicle to division commander. Transition to JISR ACTD, PM Prophet and PM ACS. Perform field test for networked RF collection capabilities as an embedded function in the SUO radio. Perform lab test for the system architecture's ability to detect, identify, and locate enemy tactical radios with a CEP of 200m or better to support the Objective Force Warfighter. Refine and optimize software algorithms to exploit enemy RF transmissions that represent threats to Future Combat Systems vehicles. Other work related to this project is performed under project K15.</p>	5262	4980	0	0
Totals	7038	7617	6420	6449

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603313A - Missile and Rocket Advanced Technology							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	76979	99695	111321	94062	67650	50871	66224	75653
206 MISSILE SIMULATION	14658	16041	3061	3263	3364	3428	3510	3590
263 FUTURE MSL TECH INTEGR(FMTI)	22643	34741	50485	31667	41275	24846	14987	14982
550 COUNTER ACTIVE PROTECTION	9476	8095	0	0	0	0	0	0
567 LCPK FOR 2.75 INCH ROCKETS	3439	0	0	0	0	0	0	0
655 HYPERVELOCITY MISSILE TD	24365	36530	48563	52774	16408	19658	21232	22757
704 ADVANCED MISSILE DEMO	0	1906	6263	6358	6603	0	19626	19614
G03 NATIONAL AEROSPACE INITIATIVE ADVANCED TECHNOLOGY	0	0	2949	0	0	2939	6869	14710
NA4 MISSILE RECYCLING PROGRAM	2398	0	0	0	0	0	0	0
NA6 ARMY MAINTENANCE/MANUFACTURING ORGANIZATION (AMMO)	0	2382	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element demonstrates advanced missile technologies to enhance weapon system lethality, survivability, agility, deployability, and affordability capabilities for the Objective Force, including the Future Combat Systems (FCS). Efforts are conducted through system simulation, design, demonstration, and test in laboratory and operational scenarios. This program element includes demonstrations of advanced tactical missiles, real-time hardware -in-the-loop simulations, and multi-role seeker technology efforts. The technologies in this PE enhance the capabilities of locating targets in clutter, lightweight missile launchers, precision guidance, hypervelocity missile flight, and missile communications, command and control. The major efforts in this program element are the Compact Kinetic Energy Missile (CKEM), Low Cost Precision Kill (LCPK), NetFires Command, Control, and Communications (C3), NetFires next generation missiles, and the hypersonic engine demonstration. The CKEM technology program will demonstrate a prime candidate to provide overwhelming lethality for the FCS Direct Fire System, with increased stowed rounds. The funding for this program was increased to accelerate prototype testing. The goal of the CKEM effort is to design, fabricate and demonstrate a direct-fire missile that offers a significant increase in cost/kill ratio and enhanced stowed-kills, when compared to current direct-fire weapon systems. The NetFires funding provides for longer range, more robust missiles, in a network of missiles and sensors. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan (AMP). The program element contains no duplication with any effort within the Military Departments. The Aviation and Missile Research, Development, and Engineering Center, U. S. Army Aviation and Missile Command, Redstone Arsenal, AL performs the work in this PE. Transition for this effort comes from work performed in PE 0602303A (Missile Technology). This PE supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603313A - Missile and Rocket Advanced Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	75396	87890	118564	88295
Current Budget (FY 2004/2005 PB)	76979	99695	111321	94062
Total Adjustments	1583	11805	-7243	5767
Congressional program reductions		-5500		
Congressional rescissions		-1697		
Congressional increases		22400		
Reprogrammings	3599	-572		
SBIR/STTR Transfer	-2016	-2826		
Adjustments to Budget Years			-7243	5767

Change Summary Explanation: Funding - FY 2005: Funds increased to support Networked Fires C3 and NetFires Block II efforts.

FY03 Congressional Adds:

Missile Simulation Technology, Project 206 (\$7700); Loitering Attack Munition for Aviation, Project 263 (\$3000); CKEM Distributed Prototyping Simulation, Project 655 (\$1200); Army Maintenance and Manufacturing Organization, Project NA6 (\$2500); M-72 LAW, Project 704 (\$2000); Volumetrically Controlled Manufacturing, Project 206 (\$6000)

Projects with no R-2A:

- (\$8095) Counter Active Protection, Project 550: The objective of this project is to continue fabrication of four third generation RFCM flight prototypes; and complete design of conformal head assemblies, complete fabrication of reduced size of radar receivers. Conduct multiple field tests of close-in Active Protection System (APS).
- (\$2382) Army Maintenance and Manufacturing Organization (AMMO), Project NA6: The objective of this one year Congressional add is to focus on remanufacturing efforts through advanced materials processing technologies. No additional funding is required to complete this effort.
- (\$1906) M-72 LAW, Project 704: The objective of this one year Congressional add is to mature and demonstrate an increased capability light anti-tank weapon for Special Operations Forces in urban environments. No additional funding is required to complete this effort.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603313A - Missile and Rocket Advanced Technology	PROJECT 206
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- Missile Simulation - In FY02, matured a high-fidelity performance assessment capability for tri-mode (MMW/RF/IR/semi-active laser) seekers and guidance hardware/software using HWIL simulation; established implementation plan for development of a life cycle support capability for tri-mode guided weapons using HWIL simulation. In FY03, mature tri-mode beam combiner technology for multi-mode guided missiles and sub-munitions; develop IR scene projector capabilities to 1024x1024 elements with frame update rates exceeding 250 Hz, and with "snap" update electronics; implement an IR in-band target scene projector based on micro-electromechanical systems (MEMS) devices for HWIL simulation. In FY04, develop Laser Detection and Ranging (LADAR) radar scene projector for HWIL simulation; mature end-to-end HWIL simulation techniques with remotely located ground equipment (launchers, C4I, fire control sensors and units) connected to real-time HWIL missile components and simulations. In FY05, design and implement distributed simulation capabilities including classified and unclassified Ethernet and fiber optic wide area and local network equipment to analyze FCS, CKEM, NetFires, the Objective Force and weaponization of manned and unmanned air and ground vehicles in conjunction with Battle Labs and other Research, Development, and Engineering Centers; investigate parallel processing techniques to provide image processing power to enhance obscuration modeling required by both real and virtual prototype simulators.	2790	2981	3061	3263
- Missile Simulation Technology – This Congressional interest item matures high fidelity, man-in-the-loop, simulation support to missile and missile platform development programs. No additional funding is required to complete this project.	6673	7340	0	0
- Volumetrically Controlled Manufacturing – This Congressional interest item matures simulation / modeling capability to optimize component design and manufacturing, using volumetrically controlled manufacturing methods. No additional funding is required to complete this project.	2410	5720	0	0
- High Bandwidth Technology – This Congressional interest item matures high bandwidth communications for the Missile Defense Agency (MDA) Pacific Rim test range effort---from Kwajalein Missile Range, Pacific Missile Range Facility, the Alaska Missile Range, and associated supercomputing centers. No additional funding is required to complete this project.	2785	0	0	0
Totals	14658	16041	3061	3263

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603313A - Missile and Rocket Advanced Technology		PROJECT 263					
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
263 FUTURE MSL TECH INTEGR(FMTI)	22643	34741	50485	31667	41275	24846	14987	14982

A. Mission Description and Budget Item Justification: This project demonstrates advanced tactical missile technologies including seekers, propulsion, airframes, communications, command and control (C3), and guidance and control for FCS and the Objective Force. The major efforts in this project are the NetFires C3 and NetFires Block II programs. These technologies include the demonstration and integration of multi-mode seeker concepts, controllable thrust rocket motors (gels or pintle-controlled solids), aided target recognition (ATR), wide-band secure data links, missile antennas, and C3 networking. Seeker technology will address imaging infrared, 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 robustness in air-to-ground, ground-to-ground, and ground-to-air roles. ATR will be demonstrated permitting true fire -and-forget at targets beyond visual range. Secure wide-band data link hardware, allowing target position updates during missile flight, and transmission of imagery to the ground will be demonstrated. NetFires C3 will mature and demonstrate a tactically appropriate C3 system providing a proof-of-principle for the larger Networked Fires architecture for the start of NetFires Block I SDD. The demonstration will consist of a tactical communications segment, a tactical networking segment, and a tactical C2 segment. The products of the program are a missile-compatible network radio (JTRS surrogate), network protocols for missiles, interfaces between missile and ground elements, a mission manager application, imagery interpreter, a distributed C2 capability, and an interface to the Objective Force C4ISR. These efforts provide risk mitigation in support of a planned System Development and Demonstration start for NetFires in FY04 and are supported by the Program Executive Officer Tactical Missiles. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. The program contains no duplication of effort within the Military Departments. The Aviation and Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL performs the work in this project. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603313A - Missile and Rocket Advanced Technology	PROJECT 263
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- NetFires C3 Threshold - In FY02, performed NetFires full system simulation in a battlefield scenario to determine technical requirements, which included identification of missile radio technical requirements, missile networking technical requirements, and C2 technical requirements. In FY03, design and test NetFires prototype 2-way missile radios with limited bandwidth, omni directional antennas, networking protocols that allow up to 25 missiles in flight, and missile manager applications that will transition into NetFires Block I SDD.	7237	14984	15400	0
- NetFires C3 Block II - In FY03, mature and test increased bandwidth missile radio, scale missile communications network to enable up to 200 missiles in flight, and initiate modifications to missile manager to facilitate reduced man-in-the-loop requirements. In FY04, mature and test NetFires command and control cell and demonstrate NetFires C3 architecture in a relevant environment. In FY05, mature and demonstrate missile network performance to handle multiple missiles in flight, transmitting more data to a ground-based automated mission manager application hosted on an Future Combat Systems (FCS) C2 computer.	0	11000	12297	14000
- NetFires Block II Missile - In FY03, mature missile on-board automatic target recognition algorithms to better handle obscured vehicles and targets with countermeasures; perform full-system simulation of the key NetFires subsystem to boost NetFires performance and/or affordability. New members of the NetFires missile family (e.g. air defense, non-lethal) will also be investigated and developed. In FY04 mature and test longer range/longer duration missile propulsion systems; develop breadboard components and software for improved missile seeker for better resolution. In FY05 demonstrate in-flight missile management, ATR, and conduct multi-functional warhead testing.	1600	3421	22788	17667
- Common Missile - In FY02, fabricated and assembled final seeker hardware for CM, and completed final fabrication of propulsion system hardware and static testing of flight-type hardware. In FY03, conduct seeker tower testing; prepare seekers and range for Captive Flight Testing; perform Captive Flight Testing of Tri-mode seekers for CM; and conduct final flight-type static testing of controllable propulsion system(s).	11106	2460	0	0
LAM-A - In FY02, accelerated demonstration and flight-testing of a full-scale LAM-A prototype; developed engineering design of soft launch boost motor and aircraft rail interface; and developed test plans to include ballistic, controlled, and guided flight testing. Project completed in FY02.	2700	0	0	0
LAM-A – This Congressional interest item funds stabilized test vehicle flight tests from a helicopter rail; continue turbofan engine development testing and perform simulations to refine and optimize command and control techniques. No additional funding is required to complete this project.	0	2876	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603313A - Missile and Rocket Advanced Technology

PROJECT

263

Accomplishments/Planned Program (continued)

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Totals	22643	34741	50485	31667

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603313A - Missile and Rocket Advanced Technology						PROJECT 655	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
655 HYPERVELOCITY MISSILE TD	24365	36530	48563	52774	16408	19658	21232	22757

A. Mission Description and Budget Item Justification: Compact Kinetic Energy Missile (CKEM) ATD will enable the Objective Force, including FCS, by providing overwhelming lethality with a small, light, fast hypervelocity compact kinetic energy missile. CKEM will demonstrate enhanced system lethality with a 52-inch long, 65-lb missile. Miniature guidance inertial measurement unit (IMU) technology will be demonstrated to survive high-g missile launch, and provide precision guidance to kill targets at ranges of 0.4-5 km. 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 the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. The program contains no duplication of effort within the Military Departments. The Aviation and Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL performs the work in this project. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603313A - Missile and Rocket Advanced Technology

655

Accomplishments/Planned Program

- CKEM - In FY02 demonstrated critical technologies applicable to FCS weapon system applications in battlefield operational environments and validated through simulation. Built missile emulator with 6 degrees of freedom. In FY03 continue demonstration of critical hypervelocity technologies in operational environments and award competitive ATD contracts to system prime contractors to complete design trade studies for ATD missile system, and finalize design, fabricate and test components/subsystems: advanced propulsion, enhanced lethality, miniaturized high-g guidance and control, and fully operational Inertial Measurement Unit (IMU). Develop fire control requirements and interface definitions for weapon system integration. In FY04 incorporate demonstrated component technologies into an integrated system and continue to perform critical technology demonstrations and subsystem integration testing and evaluation including hardware-in-the-loop to validate performance models. Conduct full-scale lethality sled tests against advanced threat armors to evaluate penetrator design performance. Integrate advanced propulsion designs into competing missile configurations; complete guidance and control test vehicle flight to characterize performance; perform constructive and virtual simulation and modeling applicable to FCS weapon system applications in battlefield operational environments and validate through utilization of battlefield simulation & modeling. In FY05, conduct integrated weapon system firing demonstration with FCS and Objective Force representative size combat vehicles.

FY 2002	FY 2003	FY 2004	FY 2005
24365	35386	48563	52774

- CKEM Distributed Prototype Simulation – This Congressional interest item funds the design of high-bandwidth tool sets for use with simulation models to provide low-cost evaluation techniques for CKEM. No additional funding is required to complete this project.

0	1144	0	0
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Totals

24365	36530	48563	52774
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603313A - Missile and Rocket Advanced Technology						PROJECT 704	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
704 ADVANCED MISSILE DEMO	0	1906	6263	6358	6603	0	19626	19614

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 FCS and the Objective 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 develop a common fire control system for the Future Combat Systems (FCS) family of vehicles. This program will leverage work performed in the Multi Role Armament and Ammunition System (MRAAS) program to develop Missile Target Pairing Algorithms (MTPA) that shall be incorporated into the Combat Decision Aid Software (CDAS) product. The resulting Validated Fire Control Software Package, Enhanced Combat Decision Aid Software (ECDAS), will enable a commander or platform 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 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. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. The program contains no duplication of effort within the Military Departments. The Aviation and Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL performs the work in this project. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this project.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- FC-NET - In FY04, design and mature technical fire control components through modeling and simulation and demonstrate technical fire control to include missile target paring algorithm. Begin integration of FC-NET system into the Enhanced Combat Decision Aid Software (ECDAS), baseline ECDAS and conduct system testing in a virtual simulation environment. In FY05, mature and demonstrate tactical fire control components using modeling and simulation and complete Tactical Fire Control Demonstration to include ECDAS.	0	0	4965	3443
- AMMPGM - In FY04, complete wind tunnel testing, fabrication and static testing of flight weight motor. In FY05, complete ballistic flight testing of flight weight motor. Transition technology and designs to APKWS Block II SDD.	0	0	1298	2915
M-72 LAW – This Congressional interest item will mature and demonstrate increased capability light anti-tank weapon (LAW) for Special Operations Forces in urban environments. No additional funding is required to complete this project.	0	1906	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603313A - Missile and Rocket Advanced Technology

PROJECT

704

Accomplishments/Planned Program (continued)

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Totals	0	1906	6263	6358

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603313A - Missile and Rocket Advanced Technology					PROJECT G03			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
G03 NATIONAL AEROSPACE INITIATIVE ADVANCED TECHNOLOGY	0	0	2949	0	0	2939	6869	14710	

A. Mission Description and Budget Item Justification: This project funds advanced technology development to mature and demonstrate the critical technologies required to develop expendable hypersonic cruise missiles and ballistic missiles. Primary technology focus areas are those deemed critical by the National Aerospace Initiative (NAI) to the advancement of national goals in hypersonic weapon development and access to space. These focus areas include scramjet engine development, hypersonic airframe aerodynamics and structures, thermal protection systems, active and passive cooling mechanisms, turbulent mixing enhancement at low Reynolds numbers, computational fluid dynamics, high yield fuel grain development and alternate methods of hypersonic missile guidance, navigation and control. Efforts will be conducted through detailed system and subcomponent simulation, design, development and test in laboratory and operational settings. Funding for this effort is provided in coordination with other DOD and government elements participating in NAI. As a result, numerous leveraging and technology insertion opportunities are available. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan (AMP). The program element contains no duplication with any effort within the Military Departments. Work is performed at the Aviation & Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL. This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

Accomplishments/Planned Program	FY 2002	FY 2003	FY 2004	FY 2005
- NAI System Studies: In FY04, detailed program management and system engineering plans will be developed, management oversight processes and integrated product teams will be established to govern program execution; system level and component level analysis of alternatives will be completed to quantify the advantages and disadvantages of various airframe and engine concepts and subcomponent options.	0	0	2949	0
Totals	0	0	2949	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603606A - Landmine Warfare and Barrier Advanced Technology							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	24718	28595	24552	25476	26640	27677	28667	32556
608 COUNTERMINE & BAR DEV	21873	25799	21537	22480	23259	23696	24207	27713
683 ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES	2845	2796	3015	2996	3381	3981	4460	4843

A. Mission Description and Budget Item Justification: The primary goal of this PE is to mature and demonstrate the sensor technologies required to detect minefields and obstacles to enable assured mobility for the high OPTEMPO Objective Force. It will also provide the US Army the capability for in-stride detection and breaching, close-in detection, area clearance, and neutralization of landmines. This PE demonstrates the remote detection of minefields as well as individual landmine detection from handheld, ground, and aerial sensor systems. Detection of both types of landmines, metallic and low/non-metallic, will be evaluated. The use of wide-area multi-sensor fusion detection systems, coupled with small-area confirmation sensors, also will be emphasized. This multi-sensor approach has the potential to yield a high probability of landmine detection at very low false alarm rates. In addition, airborne mine detectors will be assessed for contingency applications and matured for lightweight plug-and-play use in mission specific applications. Alternative systems for anti-personnel landmines and innovative concepts for minefield clearance will be explored. Advanced Concept Technology Demonstrations, Advanced Warfighting Experiments, and modeling and simulation activities will be conducted to assess the effectiveness of system concepts. Efforts within this PE are closely coordinated with the U.S. Marine Corps. The work in this program follows the Army Science and Technology Master Plan, the Army Modernization Plan and Project Reliance. The program also adheres to Tri-Service/Project Reliance Agreements on conventional air/surface weapons and ground vehicles. This PE contains no duplication with any other effort within the Army or the Department of Defense. It also is fully coordinated with PE 0603619A (Landmine Warfare and Barrier Advanced Development), PE 0602712A (Countermining Systems) and PE 0602709A (Night Vision Technology). This PE is managed by the Night Vision Electronic Sensors Directorate-Communications-Electronics Research Development and Engineering Center. This program supports the Objective Force transition path of the TCP. No Defense Emergency Response Funds (DERF) were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603606A - Landmine Warfare and Barrier Advanced Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	25640	24104	27296	31221
Current Budget (FY 2004/2005 PB)	24718	28595	24552	25476
Total Adjustments	-922	4491	-2744	-5745
Congressional program reductions				
Congressional rescissions		-938		
Congressional increases		6300		
Reprogrammings	-323	-164		
SBIR/STTR Transfer	-599	-707		
Adjustments to Budget Years			-2744	-5745

Change Summary Explanation:

Significant Changes: FY04/05 - Funds realigned to higher priority requirements.

FY03 Congressional Adds:

Electromagnetic Wave Detection and Imaging Transceiver Landmine Detection, Project 608 (\$1800); Advance Demining Technology, Project 608 (\$3500); Landmine Detection System using Terahertz Radiation Technology, Project 608 (\$1000)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603606A - Landmine Warfare and Barrier Advanced Technology					PROJECT 608			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
608 COUNTERMINE & BAR DEV	21873	25799	21537	22480	23259	23696	24207	27713	

A. Mission Description and Budget Item Justification: This project matures countermine technologies for integration into future Army systems. 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. The landmines being addressed include both metallic and low/non-metallic construction. This project will evaluate the potential for wide-area multi-sensor fusion detection systems, coupled with small-area confirmation sensors, to yield a high probability of mine detection at very low false alarm rates. Airborne multispectral mine detection sensors will be evaluated and matured for lightweight plug-and-play use in mission specific applications. The expectation is for robust approaches to finding surface-laid and buried mines in varying vegetation, soil 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, radio frequency, signal processing, electronic and physical mine marking. Neutralization technologies include chemical reactants, electromagnetic energy, and kinetic energy. The intent is to provide increased operational tempo and survivability for US Forces prior to their entry into harm's way. This project also evaluates area clearance systems under the Joint Area Clearance (JAC) Advanced Concept Technology Demonstration (ACTD) as a means to determine the best system to procure for rear area and supply route clearance operations. These efforts support ACTDs, Army Warfighting Experiment, modeling and simulation assessments and defines potential system effectiveness. This project supports the Objective Force transition path of the TCP. No Defense Emergency Response Funds (DERF) were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

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BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603606A - Landmine Warfare and Barrier Advanced Technology	PROJECT 608
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>Lightweight Airborne Multispectral Mine Detection System (LAMD) Program: In FY02, develop both active and passive imaging “plug and play” sensors for tactical unmanned aerial vehicle (TUAV) to support the lightweight airborne standoff antitank minefield and obstacle detection requirements of the Objective Force. Emphasis is on detection of surface and recently buried mines/minefields. No standoff airborne minefield detection capability currently exists. This two-pronged approach will leverage the advanced electro-optical infrared (EOIR) ATD, mid-wavelength infrared (MWIR) sensor developed to be compatible with the TUAV sensor payload, by adding a filter wheel with selectable bands optimum for minefield detection. This approach will meet Airborne Standoff Minefield Detection System (ASTAMIDS) patterned minefield detection requirements for surface and recently buried mines/minefields during select diurnal periods. The active approach, laser illuminator and gated camera with long wavelength infrared (LWIR) for false alarm mitigation will be more effective than the first approach for scatterable surface minefield detection. In FY03, the mine detection aided target recognition (ATR) (leveraged from the Cobra minefield detection program), hardware, workstations, and communication protocols will also be matured to support the ASTAMIDS acquisition program managed by PM -CSS. The active sensor is a plug and play candidate for ASTAMIDS upgrades for scatterable surface minefield detection and false alarm mitigation.</p>	8659	5328	0	0
<p>Autonomous Mine Detection Sensors Program: In FY02, this program addressed the very high-risk environment that dismounted soldiers operate in during mine clearing missions. Current capabilities require troops to be within danger-close proximity of mines and they become vulnerable to sniper fire and booby traps. In FY03, this task will develop and evaluate sensors that permit standoff operations in mine detection and clearing missions. In FY04, it will investigate and demonstrate potential robotic standoff and forward looking dismounted technologies for antitank mines; mature those technologies that have the greatest potential to meet requirements; demonstrate each technology for performance and application; build prototypes based on previous demonstrations; and integrate technologies on TRADOC identified robotic platforms. In FY05 continue maturation efforts and demonstrate system prototypes in relevant environments.</p>	1229	3005	4908	4964

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603606A - Landmine Warfare and Barrier Advanced Technology		608	
<u>Accomplishments/Planned Program (continued)</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>FCS Standoff Mine Detection System: In FY03, this task will begin demonstration of revolutionary improvements of OPTEMPO in mined areas with the use of forward looking airborne sensors that detect mines and provide, through downlink, data to Objective Force vehicles using forward looking bolt on sensors. In FY04, the task will transition the two-band, 6.2 airborne sensor; integrate the sensor on a stabilized vertical takeoff and landing (VTOL) platform; demonstrate performance; and transition the sensor to FCS. In FY04 it will advance ATRs and integrate them on Organic UAV (OUAV) for demonstration. In FY05 and later years, transition 6.2 bolt-on vehicle sensor and fusion ATRs and establish baseline performance; improve fusion ATRs; and link airborne sensors with ground vehicle suite to demonstrate performance of the combined mine detection approach.</p>	0	990	5807	5491
<p>False alarm reduction (FAR) for Improved OPTEMPO: In FY02, this program addressed the warfighter need to eliminate false alarms from mine detection systems. FAR is mission critical in order to provide the significant rates of advance required for the Objective Force. In FY03, this continuing task will evaluate scanning technologies and mine detection confirmation technologies to include wide band frequency radar and quadruple resonance sensors for false alarm reduction performance on small overpass unmanned ground vehicles. In FY04 mature and evaluate these sensor mine detection technologies, ATR's, and signal processing techniques associated with each technology. The most promising false alarm reduction technologies or combination scanning/confirmation capabilities will be integrated on a surrogate recon vehicle to demonstrate overpass capability and false alarm reduction performance.</p>	6245	8051	9446	0
<p>The Joint Area Clearance (JAC) ACTD: Program will evaluate the military utility of mine clearance systems for route and rear area operations. In FY02, conducted hardware demonstrations for Army and Marine Corps user representatives. In FY03, conduct operational demonstrations and a military assessment of candidate clearance systems. In FY05, complete maturation efforts and transition hardware with technical support to operational combat units for further evaluation. The payoff for this program is to provide safe, effective, and efficient mine clearance systems that demonstrated a utility for integrated military operations.</p>	3045	2393	500	0
<p>Advanced Demining Technology: This two-year Congressional add demonstrates a remotely operated, mine detection and mine clearing system. Efforts in FY03 will mature the system and demonstrate its capability in a relative environment.</p>	2695	3351	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603606A - Landmine Warfare and Barrier Advanced Technology		608	
<u>Accomplishments/Planned Program (continued)</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>FCS Standoff Mine Neutralization for Route Clearance: This effort will demonstrate capabilities and methodologies to provide operational standoff while clearing mines from desired routes of travel. Current methods for removing landmines located in routes of advance include 1) unearthing the mine to render the mine safe or 2) placing a charge on top of the unearthed mine and detonating. Both methods are hazardous, time consuming, and require significant logistical support to repair equipment or a road crater after a mine detonation. In FY05, this effort will build standoff prototype systems to neutralize mines on the route of travel. This effort will include electronically fused mines without causing high order detonation (road craters). The task will leverage applicable technologies such as the Navy Dart program; build two or more prototype precision neutralizers to include mine deflagration by chemical reactants and mine destruction by high velocity kinetic projectiles; and integrate neutralization components with surrogate delivery platforms to demonstrate in relevant environments.</p>	0	0	0	4080
<p>Detection & Neutralization of Off Route Mines Program: In FY04, mature and develop detection and neutralization technologies to counter the emerging threat of off route mines to include break wires, trip wires, and side attack mines. This effort will improve survivability of the Objective Force against off route mines. The task will transition and establish baseline performance of 6.2 off route short-wavelength infrared (SWIR) mine detection sensors, ATR's, and neutralization technologies to include microwave, laser neutralization approaches, precision top attack munitions, and a robotic deliverable deflagration approach. In FY05, continue maturation of off route detection and neutralization technologies, signal processing, and ATRs. Demonstrate and evaluate developed capabilities of the mine detection and neutralization system approach in a relevant environment.</p>	0	0	876	3669
<p>Airborne System for Buried Minefield Detection: In FY05, this task will build upon the LAMD efforts and will demonstrate a buried antitank minefield detection capability that does not have the diurnal constraints of the LAMD program. This task will investigate technologies optimum for buried minefield detection; build a TUAV compatible plug and play capability; investigate wide area search approaches; and demonstrate, on a TUAV platform, buried minefield detection capability and evaluate the applicability of this system for surface minefield detection. This task will address the battlefield threat of buried mines/minefields to the Objective Force.</p>	0	0	0	4276
<p>Eletromagnetic-wave Detection and Imaging Transceiver Landmine Detection: This one-year Congressional add will demonstrate the combat utility of a handheld detector integrated with the newly developed Micro-electromechanical Systems (MEMS) accelerometer for self contained sensor-head tracking. No additional funding is required to complete this project.</p>	0	1723	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603606A - Landmine Warfare and Barrier Advanced Technology	PROJECT 608			
Accomplishments/Planned Program (continued)					
Landmine Detection Using Terahertz Radiation Technology: This one-year Congressional add will develop and demonstrate a high power (peak and average) compact and portable, particle accelerator based, THz radiation source that will produce THz imagery. Potential applications for this technology are Chemical/Biological hazard identification, detection of plastic explosives, and detection of landmines in dry conditions. No additional funding is required to complete this project.	FY 2002 0	FY 2003 958	FY 2004 0	FY 2005 0	
Totals	21873	25799	21537	22480	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603606A - Landmine Warfare and Barrier Advanced Technology						PROJECT 683	
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
683 ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES	2845	2796	3015	2996	3381	3981	4460	4843

A. Mission Description and Budget Item Justification: This project is part of the Presidential mandated Antipersonnel Landmine Alternatives (APLA) effort and provides technology demonstrations of alternative systems that minimize the risk of injury or loss to non-combatants from exposure to anti-personnel landmines (APLs). This includes alternatives to anti-personnel sub-munitions used in mixed anti-tank (AT) landmine systems. The alternatives will include surveillance systems (autonomous seismic, acoustic, and day/night imaging sensor systems), command and control systems (networked, wireless, sensor communications, and information management tools), and overwatch fires. These will be evaluated and matured in parallel in order to provide similar capabilities that are currently provided by APLs and APL sub-munitions in mixed Anti-Tank systems. Distributed simulation will be used to evaluate new concepts and modify doctrine. Modeling components and system architectures will be constructed and evaluated at the system level in field tests. This project supports the Objective Force transition path of the TCP. No Defense Emergency Funds (DERF) were provided to the project.

Accomplishments/Planned Program	FY 2002	FY 2003	FY 2004	FY 2005
Anti-Personnel Landmine Alternatives: In FY02, developed component technology (sensors, communications and munitions) for inclusion into the PM-Close Combat Support Track 1 and Track 3 APL-A program. In FY03, mature component technology and address Track integration and interoperability issues. In FY04, efforts will be towards development of secure inter-field and intra-field radios, establishing detection and identification distances against dismounted troops, and increasing the lethality of anti-personnel munitions. In FY05, continue maturation of capability and demonstrate at system level in a relevant environment.	2845	2796	3015	2996
Totals	2845	2796	3015	2996

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603607A - JOINT SERVICE SMALL ARMS PROGRAM					PROJECT 627			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
627 JT SVC SA PROG (JSSAP)	4264	12998	6193	5979	6874	7196	7356	7526	

A. Mission Description and Budget Item Justification: Matures and demonstrates advanced technologies that integrate into individual and crew-served weapons to provide greater lethality, utility and range at a significantly reduced weight for the Objective Force. Efforts include: the Objective Crew-Served Weapon (OCSW) Advanced Technology Demonstration (ATD); and Objective Individual Combat Weapon (OICW) System Enhancement; and the Lightweight Machine Gun and Ammunition (LMGA). OCSW demonstrates the next generation crew-served weapon with improved combat effectiveness such as being able to hit protected personnel targets in defilade (obscured or non-visible), a reduced weight MK19 grenade machine gun and M2 machine gun,. The OICW system enhancement efforts will develop, demonstrate and transition lethality-enhancing and cost/weight-reducing technologies into the OCSW and OICW. The LMGA , complementing both the highly lethal OICW and OCSW will offer significantly reduced weight over the currently fielded M249 SAW 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 current levels of performance. All Joint Service Small Arms Program (JSSAP) efforts follow the Joint Service Small Arms Master Plan (JSSAMP) and Service Mission Need Statements and Operational Requirement Documents. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. The program element contains no duplication with any effort within the Military Departments. Work is performed by the US Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is derived and fully integrated with the 6.2 efforts found 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 Soldier, Project Manager Soldier Weapons, Product Manager Small Arms, PM Product Manager OICW; USMC Director, Ground Weapons; and US Special Operations Command (SOCOM). This program supports the Objective transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to this program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603607A - JOINT SERVICE SMALL ARMS PROGRAM		627	
<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- OCSW: In FY02, demonstrated gun launched, fully functional, airburst fuze (including point detonation functions) of the airburst high explosive munition; completed fabrication of deliverable OCSW systems; conducted integration tests; demonstrated weapon reliability growth; demonstrated ammunition airburst precision. In FY03, demonstrate accuracy and function of ai-bursting high explosive munition; fabricate test quantities of munitions; conduct environmental testing of weapon; extend limits of man-rated firing; conduct final system integration test; conduct system acceptance test. Complete ATD. Provide technical support to Milestone B decision review.	1357	3215	0	0
- OICW System Enhancement: In FY02, updated initial designs, fabricated test hardware, and evaluated in inert warheads the performance of Microelectromechanical System (MEMS) based safe and arming (S&A) mechanism employing Micro Scale Firetrain (MSF), which provides a 75% volume/50% cost reduction in the fuze S&A. In FY03, perform MEMS based S&A and fuze integration and conduct fuze/warhead performance and safety tests. In FY 04, continue OICW 20mm system integration, complete testing and quantify production costs.	2907	2431	4413	0
- LMGA: In FY04, award contracts to design a lightweight, reliable machine gun and ammunition. In FY05, conduct initial integration tests with OFW Lead Technology Integrator and downselect to final weapon design. Build and test initial weapon and ammunition components.	0	0	1780	5979
- Objective Crew Served Weapon: The objective of this one year Congressional Add is to reduce risk in the System Development and Demonstration Phase by further maturing the OCSW airburst fuze; demonstrate a fully integrated airburst round; further increase the reliability of the system and support the conduct of Milestone B.	0	3342	0	0
- Anti-material Sniper Rifle: The objective of this one year Congressional Add is to evaluate weapon technologies in the areas of light weight materials, recoil mitigation and energy recovery and demonstrate these in a 25mm Anti-Material Sniper Rifle technology based on the XM107 .50 caliber Sniper Rifle, which is compatible with the XM307, Objective Crew Served Weapon Ammunition.	0	4010	0	0
Totals	4264	12998	6193	5979

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603607A - JOINT SERVICE SMALL ARMS PROGRAM

PROJECT
627

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	4388	6013	6413	6715
Current Budget (FY 2004/2005 PB)	4264	12998	6193	5979
Total Adjustments	-124	6985	-220	-736
Congressional program reductions				
Congressional rescissions		-289		
Congressional increases		7700		
Reprogrammings	-20	-75		
SBIR/STTR Transfer	-104	-351		
Adjustments to Budget Years			-220	-736

Significant Changes:

FY05: Funds realigned to higher priority requirements.

FY03 Congressional Adds:

Objective Crew Served Weapon, Project 627 (\$3500); Anti-material Sniper Rifle, Project 627 (\$4200).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603654A - Line-Of-Sight Technology Demonstration	PROJECT 460						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
460 LOSAT TECHNOLOGY DEMO	72530	26955	8847	0	0	0	0	0

A. Mission Description and Budget Item Justification: Line-of-Sight Anti-Tank (LOSAT) and the Kinetic Energy Missile (KEM) technology provide the foundation for the Objective Force. This program focuses on the integration of the LOSAT weapon system into a light, early deployable configuration in order to help remedy the urgent need for the early entry force lethality shortfall against heavy armor in support of the Army Transformation. The LOSAT weapon system consists of a kinetic energy (KE) missile launcher mounted on a heavy High Mobility Multi-purpose Wheeled Vehicle (HMMWV) chassis. LOSAT offers a highly mobile, near-term, advanced capability for overwhelming armor destruction with a high rate of fire, increased range, and increased force survivability. LOSAT, deployed in the early entry force, will provide the decisive edge to win swiftly with minimum casualties and provides an assault support weapon capability. LOSAT is strategically and tactically deployable, giving Commanders and decision makers greater flexibility. Once in theater, LOSAT is extremely mobile, to include air droppable and sling loading under CH-47 and UH-60L aircraft. The performance of this hypervelocity kinetic energy missile (velocity of a mile per second) is not affected by the proliferation of emerging threat active protective systems and enhanced reactive armors, which are both rapidly becoming available on the global marketplace. LOSAT was initiated as a DoD-approved Advanced Concept Technology Demonstration (ACTD) program in FY 1998 to position the technology for future acquisition decisions; demonstrate subsystem capabilities in flight tests and dirty battlefield environments; evaluate the utility of the LOSAT technology for the early entry forces; demonstrate an integrated HMMWV-based LOSAT system in-flight tests and advanced war fighting experiments; and evaluate affordability issues. The ACTD program is a cost-effective means to assess the operational value of LOSAT to the early entry force through deployment with the XVIII Airborne Corps while longer-term applied research efforts continue for a small Compact Kinetic Energy Missile and an objective Future Combat System. The work in this program element is consistent with the Army Science and Technology Master Plan, and the Army Modernization Plan. In December 1999, the Army and OSD funded the LOSAT accelerated advanced development and procurement as part of the Army Transformation by adding additional design activities, reducing risk, completing system qualification testing, and adding additional Operational tests to support transition to limited production of the LOSAT Weapon System, with entry into Low Rate Initial Production (LRIP) starting in FY 2004. This ACTD Plus System Development and Demonstration (SDD) effort is funded in PE 0604819A and is concurrent with the ACTD contract. This system supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds have been provided to this program.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
In FY02 completed Fire Unit detail designs.	34229	0	0	0
In FY02 completed Missile detail designs.	19238	0	0	0
In FY02 completed tool design and fabrication.	1646	0	0	0
In FY02 completed Virtual Prototype Simulator Upgrade.	1130	0	0	0
In FY02 completed Training Device designs and fabrication.	1202	0	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced technology development

0603654A - Line-Of-Sight Technology Demonstration

460

Accomplishments/Planned Program (continued)

	FY 2002	FY 2003	FY 2004	FY 2005
In FY03 support system ground and flight qualification tests, safety certification, and man-rating assessment.	0	5130	0	0
In FY02-04, fabrication, assembly, qualification and test support for 12 prototype Fire Units.	6100	12606	694	0
In FY02-04, fabrication, assembly, qualification testing, and flight testing of 37 prototype missiles.	4809	7339	5653	0
In FY02-03, Fire Unit and Missile software design, code and unit level test, system level test and certification.	3280	880	0	0
In FY02-04, support Early Soldier involvement training and execute force on force DBBL Demonstration.	896	1000	2500	0
Totals	72530	26955	8847	0

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	69859	28283	0	0
Current Budget (FY 2004/2005 PB)	72530	26955	8847	0
Total Adjustments	2671	-1328	8847	0
Congressional program reductions				
Congressional rescissions		-396		
Congressional increases				
Reprogrammings	2671	-155		
SBIR/STTR Transfer		-777		
Adjustments to Budget Years			8847	

Change Summary Explanation: Funding - FY 2004: Funds increased to support completion of the LOSAT ACTD in FY04.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603710A - NIGHT VISION ADVANCED TECHNOLOGY

COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	54913	73609	47088	54635	62227	61928	50942	48330
590 OVERWATCH ACTD	0	0	1867	5889	1373	490	0	0
C65 DC65	2767	2738	9295	10346	6357	4544	3391	3466
C67 DC67	8774	5619	0	0	0	0	0	0
K70 NIGHT VISION ADV TECH	30740	40946	27689	20013	25346	28220	32403	32377
K86 NIGHT VISION, ABN SYS	9277	24306	8237	18387	29151	28674	15148	12487
NA1 THROUGH WALL SURVEILLANCE RADAR TECHNOLOGY	3355	0	0	0	0	0	0	0

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 the dark, i.e., "own the night." 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). The Network Sensors for the Objective Force program will provide a system of networked, low-cost, distributed unmanned sensors for close-in battlefield situational awareness and beyond-line-of-sight targeting in areas shadowed by terrain features. A Disposable Sensors Network program will demonstrate new lightweight low-cost unattended ground sensors that will provide increased situational awareness and force protection capabilities for the Future Combat Systems (FCS) and Objective Force Warrior (OFW). This program also demonstrates mission equipment packages for Unmanned Aerial Vehicles that enable small, lightweight, interchangeable payloads of varying sizes to support target detection, identification, and location for the Unit of Action. The Hyperspectral Airborne Multi-Mission Exploitation and Reconnaissance (HAMMER) effort demonstrates sensors and algorithms designed to detect mines and targets in camouflage, concealment and deception. The head tracked sensor suites program will demonstrate situational awareness for FCS infantry carriers operating in close-in complex terrain. The low power infrared (IR) sensors program will demonstrate lightweight, affordable day/night imaging capability for the OFW. The Overwatch ACTD will mature and demonstrate detection, location, and classification of small arms, mortars, and rocket propelled grenades (RPGs) in complex terrain and provide situational awareness information to the warfighter for action. Work in this PE is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan and Project Reliance. It adheres to Tri-Service Reliance agreements on sensors and electronic devices, with oversight, and coordination provided by the Joint Directors of Laboratories. This PE contains no duplication with any effort within the Military Departments and 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). Work in this PE is managed by the US Army Communications-Electronics Research, Development and Engineering Center, Fort Monmouth, NJ. This system supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program/project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603710A - NIGHT VISION ADVANCED TECHNOLOGY

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	49389	36494	39336	36831
Current Budget (FY 2004/2005 PB)	54913	73609	47088	54635
Total Adjustments	5524	37115	7752	17804
Congressional program reductions				
Congressional rescissions		-1489		
Congressional increases		41050		
Reprogrammings	6821	-422		
SBIR/STTR Transfer	-1297	-2024		
Adjustments to Budget Years			7752	17804

Significant Changes:

FY04-05: Funds increased investments in networked sensors for the Objective Force ATD, mission equipment package for the Organic UAV, and a new hyperspectral airborne multi-mission and reconnaissance effort.

FY03 Congressional Adds:

Passive Millimeter Wave Imager, Project K86 (\$6000); BUSTER UAV, Project K86 (\$10000); Personal Miniature Thermal Vision System, Project K70 (\$1000); Multi-Color, Multi-Functional Focal Plane Array, Project K70 (\$2500); Sensor Technology for Force Protection, Project K70 (\$11050); Firefighter and Warfighter Helmet mounted thermal imaging Camera, Project K70 (\$1000); Night Vision Fusion, Project K70 (\$3150); Warfighter/Firefighter Position, Location and Tracking, Project K70 (\$2100) - (\$4250) AN/TAS-4 Upgrade Program, K70.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603710A - NIGHT VISION ADVANCED TECHNOLOGY	PROJECT 590						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
590 OVERWATCH ACTD	0	0	1867	5889	1373	490	0	0

A. Mission Description and Budget Item Justification: This project matures the technology and capability to provide real-time detection, location, and classification of small arms, mortars, and rocket propelled grenades (RPGs) in complex terrain and demonstrates the capability within an Advanced Concept Technology Demonstration (ACTD) by providing the information to the warfighter for action. This ACTD focuses on assessing the military utility and developing concepts of operation addressing mobile force protection for unit of action forces involved in operations across the spectrum of conflict, from close combat to peacekeeping operations by locating enemy activity and real-time reporting of counter targeting information. The ACTD will mature and integrate a sensor/processor suite containing mid-wave infrared sensor, long-wave infrared imaging sensor, laser ranger/designator on a HMMWV and an unmanned ground vehicle (UGV) along with the appropriate C4I interfaces to disseminate information. Final product for the ACTD is a technology demonstrator to determine operational utility and deliver system performance specifications in support of the Future Combat Systems and Objective Force requirements. Other agencies participating include the Office of the Secretary of Defense and USMC (in-kind contributions). This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

<u>Accomplishments/Planned Program</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- In FY04, mature Overwatch ACTD threat signature database to support real time classification algorithms for small caliber weapons; mature infrared sensor data read-out performance and integrate 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, communications hardware integration and demonstrate sensor/processor on a HMMWV. Continue hardware/software maturity and conduct initial full scale functionality test on an unmanned ground vehicle.	0	0	1867	5889
Totals	0	0	1867	5889

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603710A - NIGHT VISION ADVANCED TECHNOLOGY					PROJECT K70			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
K70 NIGHT VISION ADV TECH	30740	40946	27689	20013	25346	28220	32403	32377	

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 threats that are beyond today's tactical lines-of-sight 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 Objective Force. This project will demonstrate ground-based aided target detection/recognition 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 Multi-function Staring Sensor Suite (MFS3) effort will demonstrate a compact, affordable sensor suite for long-range noncooperative target identification applicable to ground vehicles, amphibious assault vehicles and surface ships. The Networked Sensors for the Objective Force (NSfOF) Advanced Technology Demonstration (ATD) will demonstrate beyond-line-of-sight day/night targeting and situational awareness by developing sensors and software that complement higher echelon surveillance for the Objective Force (OF). The NSfOF effort will demonstrate next-generation, distributed, unattended ground sensor systems (UGS) incorporating low-power infrared imaging and robust networking/communication technologies; 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. The Target Acquisition Sensor Suite (TASS) effort will demonstrate ground-based aided target detection/recognition utilizing short wave infrared components. The Disposable Sensors Network effort will mature and demonstrate a new class of lightweight, low-cost, disposable UGS systems that can be remotely delivered or hand emplaced and utilize various sensor technologies (acoustic, seismic, magnetic, infrared, imaging, environmental, and electronic/radio frequency) and algorithms to improve target detection, target identification, multi-target tracking, and information management. The Head Tracked Sensor Suite 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. This system supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603710A - NIGHT VISION ADVANCED TECHNOLOGY		K70	
<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Network Sensors for the Objective Force. In FY02, conducted flight test of FCS threshold sensor concept on a surrogate small unmanned aerial vehicle (SUAV). In FY03, evaluate sensor cross-cueing through emerging command and control (C2) tools. Analyze operational feedback and integrate into Program Manager-FCS system architecture. In FY04, complete and integrate low-cost targeting sensor system on the unmanned ground vehicle and advanced sensor package on the SUAV and demonstrate a self-healing network w/ >50 UGS nodes. In FY05, integrate sensor management into surrogate demonstrator platform.	7500	8313	16562	9000
Commanders Head Tracked Sensor Suite STO (III.IS.2002.02). In FY02, established performance and design requirements, system interoperability, and system modeling/simulation specifications for a vehicle mounted head tracked situational awareness (SA) sensor suite. In FY03, demonstrate capability of critical components used in the head tracked system for achieving closed hatch SA and connectivity for coordinated fights. In FY04, integrate laser coding, intrusion detection, situational awareness network interface, and high performance FLIR into the Head Tracked Sensor System (HTSS). Integrate HTSS onto a combat vehicle and demonstrate HTSS image fusion, coded laser pointing and SA network integration. In FY05, conduct limited user test.	1599	2111	4926	3134
Low Power Uncooled Infrared Sensor. In FY02, fabricated uncooled thermal imaging modules with high pixel density. In FY03, complete maturation and laboratory characterization of high pixel density uncooled thermal imaging modules, thermal imaging cameras, and self-contained weapon sights. Perform and assess operational field test and user evaluations.	5685	4114	0	0
Helmet Mounted Infrared Sensor System. In FY02, demonstrated a helmet mounted infrared sensor system for search and rescue in this Congressionally added program. In FY03, mature technology and demonstrate capability in a relative environment.	1152	955	0	0
Multi-Function Staring Sensor Suite (MFS3). In FY02, demonstrated automatic wide area search, aided target detection/recognition algorithm and multiple hypothesis tracking. In FY03, demonstrate 2.5x ID range and 10x increase in azimuth field of regard. Complete integration of MFS3 hardware into testbed platform and conduct exit criteria demonstration.	3975	2098	0	0
Joint Intelligence, Surveillance, and Reconnaissance (JISR) Program. In FY02, constructed an architecture for sensor interface and management systems (SIAMS) to enable seamless access to tactical sensor data from Army and joint Command, Control, Communications, Computers and Intelligence systems. In FY03, will provide sensor and SIAMS simulation support to JISR demonstration and evaluation in warfighter exercises.	850	398	0	0
Digital Fusion. In FY02, this two-year Congressional add demonstrated combined/fusion image intensification and thermal imagery. In FY03, demonstrate technology in a relative environment. No additional funding is required to complete this project.	2879	3007	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE			
3 - Advanced technology development	0603710A - NIGHT VISION ADVANCED TECHNOLOGY			
	PROJECT K70			
<u>Accomplishments/Planned Program (continued)</u>	FY 2002	FY 2003	FY 2004	FY 2005
Disposable Sensors Network. In FY04, conduct Market Survey & Trade Study Analysis to assess maturity and availability of applicable emerging technologies. Focus will be on MEMS-based transducers and low-cost communications. Establish disposable sensor testbed to explore novel system concepts and algorithms for detection, classification, and location of targets/events. In FY05, demonstrate novel system concepts and measure/predict performance parameters. Initiate design and proof-of-principle hardware development for promising disposable sensor system concepts.	0	0	2643	3747
Target Acquisition Sensor Suite (TASS) Technology Maturity Demonstrator. In FY04, complete system modeling and design, sub-system interface definition, and forward looking infrared-aided target recognition (FLIR-ATR) interface definition for FCS Reconnaissance, Surveillance, Target Acquisition (RSTA). In FY 05, complete system integration and conduct imagery data collection at various test sites.	0	0	2677	2258
3rd Generation Infrared Technology. In FY04, begin modification to the original Multifunction Staring Sensor Suite (MFS3) for insertion of a two-color manufacturing technology (Man Tech) dewar assembly. In FY05, integrate UAV detection and tracking and add the sensor to shooter linkage into network systems.	0	0	881	1874
Sensor Technology for Force Protection Project: The objective of this one-year Congressional add is to demonstrate an advanced mobile force protection system designed to protect high threat CONUS (Homeland Security) or in theater assets. The demonstration will be conducted like an ACTD field evaluation. No additional funding is required to complete this project.	0	10548	0	0
AN/TAS-4 Upgrade Project: The objective of this one-year Congressional add is to improve performance with use of new staring focal plane array and to reduce operational and support cost for the currently fielded systems. No additional funding is required to complete this project.	0	4057	0	0
Focal Plane Array (FPA) for Targeting and Fire Control Project: The objective of this one-year Congressional add is to demonstrate a multi-color, multi-functional, and multi-spectral FPA to support FCS Block II targeting requirements. No additional funding is required to complete this project.	0	2386	0	0
Warfighter/Firefighter Position, Location, and Tracking Project: The objective of this one-year Congressional add is to demonstrate a system to locate friendly units in military operations in urban terrain (MOUT) and complex urban terrain. This project supports the Homeland Security initiative and OFW. No additional funding is required to complete this project.	0	2004	0	0
Personal Miniature Thermal Vision System: The objective of this one-year Congressional add is to develop and demonstrate a miniature 320x240 uncooled IR camera. This effort supports the Counter-Terrorism initiative and OFW. No additional funding is required to complete this project.	0	955	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603710A - NIGHT VISION ADVANCED TECHNOLOGY	PROJECT K70
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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Camera Assisted Monitoring System (CAMS): The objective of this one-year Congressional add was to develop and demonstrate a capability for tactical surveillance, force protection, and potential homeland security applications. In FY02, demonstrated a mobile sensor system that includes on-board sensors, unattended ground sensors, and thermal imaging devices.	7100	0	0	0
Totals	30740	40946	27689	20013

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603710A - NIGHT VISION ADVANCED TECHNOLOGY					PROJECT K86		
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
K86 NIGHT VISION, ABN SYS	9277	24306	8237	18387	29151	28674	15148	12487

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 Objective Force aviation and netted systems. The goal is to provide the Army's Objective Force the capability to detect and identify partially obscured targets from manned and lightweight, low cost unmanned air platforms and to perform reconnaissance, surveillance, and target acquisition beyond today's tactical line-of-sight. This capability is critical to the survivability of the Objective Forces' light maneuver forces. The technology efforts focus on improved night pilotage sensors, high-resolution heads-up displays, sensor fusion, and aided target recognition (ATR) capabilities for current and future helicopters (attack, scout, cargo, and utility). The Networked Sensors for the Objective Force Advanced Technology Demonstration (ATD) project will mature day/night targeting sensors and software for an Organic Air Vehicle (OAV) and Micro Air Vehicle (MAV) for the Objective Force. Technologies to be addressed include automated flight control and ultra-light payloads for UAVs. The mission equipment package for an organic unmanned aerial vehicle will demonstrate small, lightweight, interchangeable payloads (electro-optical/infrared, laser radar) to support target detection, identification, and location for the Unit of Action. The mission equipment package for MAV will demonstrate very small, very lightweight, interchangeable payloads (electro-optic, thermal, acoustic, chemical) to support intelligence, surveillance, and reconnaissance requirements for the Unit of Action. The advanced night vision goggles (ANVG) ATD demonstrates a lightweight, low cost, and panoramic night pilotage and driving capability for the soldier. The Hyperspectral Airborne Multi-Mission Exploitation and Reconnaissance (HAMMER) effort will conduct sensor and algorithm development to provide countermeasure and camouflage, concealment and deception (CC&D) detection and targeting. The Long Range Identification for Aviation effort will improve survivability and lethality by providing identification at detection ranges. Technologies matured under this project are also applicable to night flying requirements of the other Services and the Special Operations Command's rotary wing aircraft. This system supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program/project.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Advanced Night Vision Goggle (ANVG). In FY02, conducted initial development and integration of forward looking infrared (FLIR) with ANVG for ground applications, built prototypes and conducted field-of-view test. In FY03, build and test FLIR/image intensifier configuration; conduct flight test on air ANVG. Conduct pre-system development and demonstration activities for ANVG.	3600	2586	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced technology development	0603710A - NIGHT VISION ADVANCED TECHNOLOGY		K86	
<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Hyperspectral Airborne Multi-Mission Exploitation and Reconnaissance (HAMMER) Program. In FY03, experimental data and phenomenology analysis will be conducted to determine sensor parameters. In FY04, sensor design modifications will be finalized. In FY05, continue development of countermine and target exploitation algorithms and implement in real time code. Demonstrate a 50-80% probability of detection for CC&D targets and a 75-90% probability of detection for minefields.	0	868	978	1500
Network Sensors for the Objective Force ATD: In FY03, integrate and demonstrate day/night targeting sensors and geo-registered imaging software. In FY04, integrate sensor prototypes, networked communication and sensor data management to form a network of distributed sensors. In FY05, demonstrate network system in an operational environment.	0	5585	2357	5637
Mission Equipment Packages for Organic Aerial Vehicle (OAV). In FY 04, establish sensor concepts and designs maximizing OAV utility. In FY05, begin development of selected payload designs including ISR and foliage penetration.	0	0	3444	8925
Lightweight Man-portable (Backpack) Unmanned Aerial Vehicle. In FY02, this two-year Congressional add demonstrated a backpack unmanned aerial vehicle. In FY03, develop miniaturized sensors, mature sensor payloads, and conduct performance and reliability test and evaluations. No additional funding is required to complete this project.	4832	9542	0	0
Long Range ID for Aviation. In FY04, evaluate and quantify the applicability of advanced technologies based on visible, laser augmented short wave IR, mid wave IR and Gen III thermal imaging for improved long range identification in airborne applications. In FY05 initiate detail design work for winning approaches.	0	0	1458	2325
Joint, Intelligence, Surveillance and Reconnaissance (JISR). In FY02, constructed architecture for sensor interface and management systems (SIAMS). Provided sensor and SIAMS simulation support to JISR demonstration and evaluation in warfighter exercises.	845	0	0	0
Passive Millimeter Wave Imager Project: The objective of this one-year Congressional Add is to demonstrate a passive see-through fog imaging capability to support a USSOCOM aviation requirement. No additional funding is required to complete this project.	0	5725	0	0
Totals	9277	24306	8237	18387

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development		PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	7026	12846	15776	14897	13132	14075	15051	16508
002 ENVIRONMENTAL COMPLIANCE TECHNOLOGY	2609	1756	1417	666	1369	1985	2034	2080
025 POLLUTION PREVENTION TECHNOLOGY	0	806	2362	2832	3315	3472	3557	3638
03E ENVIRONMENTAL RESTORATION TECHNOLOGY	1059	5995	11997	11399	8448	8618	9460	10790
EM3 PROTON EXCHANGE MEMBRANE FUEL CELL DEMO	3358	4289	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 Objective Force. 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 technology operability and producibility, and transitions technology from the laboratory to field use. 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 the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center and the U.S. Army Materiel Command. This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603728A - Environmental Quality Technology Demonstrations

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	7292	8980	9854	7172
Current Budget (FY 2004/2005 PB)	7026	12846	15776	14897
Total Adjustments	-266	3866	5922	7725
Congressional program reductions				
Congressional rescissions		-189		
Congressional increases		4500		
Reprogrammings	-64	-74		
SBIR/STTR Transfer	-202	-371		
Adjustments to Budget Years			5922	7725

Change Summary Explanation: Funding - FY 2004/2005: Funds increased to support environmental restoration technology development efforts.

FY03 Congressional Adds:

Proton Exchange Membrane Fuel Cell Demonstration Program, Project EM3 (\$4500).

Projects with no R-2As:

-\$4500 Proton Exchange Membrane Fuel Cell Demonstration Program, Project EM3: The objective of this one year Congressional Add is to purchase, install, monitor, and maintain residential PEM fuel cell equipment at a limited number of military installations. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations					PROJECT 002			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
002 ENVIRONMENTAL COMPLIANCE TECHNOLOGY	2609	1756	1417	666	1369	1985	2034	2080	

A. Mission Description and Budget Item Justification: This project will mature and demonstrate technology for achieving environmental compliance at Army installations. Technology demonstrated 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. 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 the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations	PROJECT 002
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
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 FY02, demonstrated in situ extraction technologies for lead in soil to reduce lead levels to below the Environmental Protection Agency's level of concern (400 ppm). Demonstrated activated carbon control technology to control hazardous organic solvent emissions from Army industrial facilities. Demonstrated a method and biofiltration system apparatus (patent filed) for treating volatile organic compounds, odors, and biodegradable aerosol/particulates in air emissions. In FY03, demonstrate lead removal technologies that result in non-hazardous waste that leaches less than the U.S. Environmental Protection Agency criterion of 5 ppm lead. Demonstrate rotating media biofilter technology for control of hazardous air pollutants emissions from surface coating and cleaning operations. In FY04, demonstrate zero emission control system for control of HAP emissions from chromium plating operations. In FY05, demonstrate complete emission control system for demil furnaces.	2609	1756	1417	666
Totals	2609	1756	1417	666

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations	PROJECT 025						
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
025 POLLUTION PREVENTION TECHNOLOGY	0	806	2362	2832	3315	3472	3557	3638

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 and processes to comply with existing and new national laws and local regulations, (2) demonstration of advanced technologies for the reuse and recycling of solid waste resulting from barracks and motor pool modernization programs required to meet the operational needs of the Objective 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 program element 0602720A, project 895, and will ensure that advanced energetic materials required for FCS high performance munitions are developed that meet weapons lethality and survivability stretch goals. The work is performed at the U.S Army Research Laboratory, Aberdeen Proving Ground, MD, the U.S. Army Engineer Research and Development Center, Champaign, IL, and the Aviation and Missile Research, Development and Engineering Center, Huntsville, AL. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), and the Army Modernization. The project contains no duplication of effort within the military departments. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations	PROJECT 025
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Sustainable Painting Operations – In FY03, reformulate, evaluate, qualify and implement hazardous air pollutant (HAP) free rubber-to-metal bonding materials and procedures. In FY04, demonstrate HAP free general and high performance munitions coating materials. In FY05, demonstrate HAP free solvents for repainting. Solid Waste Diversion - In FY05, demonstrate advanced technologies for the reuse and recycling of solid waste resulting from barracks and motor pool modernization programs. Ordnance Manufacture, Maintenance, Use, and Surveillance - In FY05, demonstrate benign propellant alternatives that eliminate or significantly reduce the environmental impacts associated with the manufacture, maintenance, use and surveillance of rocket and missile propellants.	0	806	2362	2832
Totals	0	806	2362	2832

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations					PROJECT 03E			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
03E ENVIRONMENTAL RESTORATION TECHNOLOGY	1059	5995	11997	11399	8448	8618	9460	10790	

A. Mission Description and Budget Item Justification: This project will mature and demonstrate technologies to improve the Army's ability to achieve cost-effective environmental restoration of contaminated sites at its installations, active and inactive ranges, and its rework and production facilities. Technologies demonstrated within this project focus on reducing the cost of remediation of Army sites contaminated by hazardous/toxic material and are transitioned from program element 0602720A, projects F25 and 835. Efforts under this project will enable the Army to prevent pollution of the air, soil, and groundwater at installations, ranges, facilities, and operations, and to comply with the myriad of Federal, state, and host country regulations dealing with contaminated soil and groundwater. This program includes demonstrations of proof of technological feasibility and assessments of operability and productivity, and includes technology transition from the laboratory to demonstration/validation funded under RDT&E program element 0603779A, project 04E. The program is supported by the Office of the Secretary of Defense's Technology Area Review and Assessment process. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), and the Army Modernization. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations	PROJECT 03E
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
UXO – Demonstrate high probability of detecting buried UXO and reduce false alarms caused by non-UXO clutter through the advancement of sensing technology and data analysis. Develop removal and recovery technologies for UXO in shallow water and difficult terrain and develop hazard assessment models for planning UXO excavation and removal. These technologies are critical for the Army to increase safety of removal, to design appropriate removal operations, and to reduce removal costs. In FY02, evaluated off-the-shelf UXO sensor positioning and tracking technologies. In FY03, formulate a demonstration plan for a series of UXO detection/discrimination multi-sensing and processing data acquisition/data analysis methods, each tailored to a specific set of site environmental conditions. In FY04, demonstrate an integrated suite of UXO detection multi-sensing and processing modes optimized for site-specific environmental characteristics. Fabricate an optimized multi-sensor and data fusion analysis UXO detection/discrimination system. In FY05, demonstrate safe means of removal of soil and sediment from around suspected UXO. Develop model that can assess the explosives safety hazards at individual UXO sites.	149	2038	1897	2180
Hazard/Risk Assessment Tools for Military Unique Compounds – Develop an integrated modeling platform for hazard/risk management and assessment that will reduce time and cost for risk assessment and for evaluating various cleanup scenarios at Army sites. In FY02, demonstrated prediction of contaminant fate and transport and prediction of spatial and temporal risk of effect to specific endpoint organisms at reduced time and cost with the Army Risk Assessment Modeling System (ARAMS). In FY03, link comprehensive screening toxicity and bioaccumulation models to ARAMS. In FY04, demonstrate a rigorous ARAMS that seamlessly links models of exposure/effects with toxicological data for multiple species. In FY05, complete advanced version of ARAMS capable of assessing multiple media and exposure pathways with uptake and transfer to environmental endpoints.	910	3957	4563	3148
In Situ Remediation Technologies for Contaminated Groundwater and Soils – Demonstrate in situ (in place without pumping or excavation) treatment technologies to remediate Army sites contaminated with explosives and other organic contaminants and with heavy metals. In FY04, demonstrate technology for in situ biodegradation of explosives in groundwater; demonstrate commercial off-the-shelf technologies for analyzing or detecting military unique compounds on site. In FY05, demonstrate advanced electro-kinetic treatment technologies for lead removal from soils; demonstrate in situ reactive barriers and/or reactive barriers coupled with biodegradation for treating explosives in groundwater and base hydrolysis for explosives contamination.	0	0	3628	3518

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603728A - Environmental Quality Technology Demonstrations		PROJECT 03E	
<u>Accomplishments/Planned Program (continued)</u> Characterization, Evaluation and Remediation of Distributed Source Contamination on Army Ranges – Demonstrate cost effective remediation and management technologies for contaminants widely distributed over large areas on active and inactive Army ranges and facilities. In FY04, demonstrate aggressive chemical metal treatment alternatives for small arms training ranges. Demonstrate recycling metal contaminated extracts for soils treatment systems. In FY05, develop predictive model for distributed source contamination impacts on inactive and live fire training ranges. Adapt hazardous wastes site restoration processes and techniques for application to distributed contamination sources on inactive and live fire ranges. Demonstrate distributed source contamination restoration techniques on inactive and live fire ranges.	FY 2002 0	FY 2003 0	FY 2004 1909	FY 2005 2553
Totals	1059	5995	11997	11399

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603734A - Military Engineering Advanced Technology							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	4554	13696	3441	3926	5448	6108	6256	6399
T08 COMBAT ENG SYSTEMS	4554	2783	3441	3926	5448	6108	6256	6399
T13 STATIONARY FUEL CELL TECHNOLOGIES	0	10913	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this project is to mature and demonstrate advanced military engineering technologies that support the Objective Force by improving capability to conduct logistics-over-the-shore (LOTS) operations in support of the Army's force projection goals. The inability to operate in rough seas and over soft beaches currently limits LOTS operations. A Rapidly Installed Breakwater (RIB) mitigates severe seas to permit off-loading ships, and mechanical reinforcement stabilizes the beach to permit traffic passage across the beach. Joint Rapid Airfield Construction (JRAC) technologies will support the expedient upgrading of existing airfields and rapid construction of new contingency airfields. Current construction technologies take too long. JRAC's terrain based site selection algorithms, computer assisted construction equipment, and fast curing soil stabilization chemical technologies support Army force projection goals. The time required to double the throughput of a minimal airfield will be reduced from four to two days. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced technology development

0603734A - Military Engineering Advanced Technology

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	4705	2921	10004	8831
Current Budget (FY 2004/2005 PB)	4554	13696	3441	3926
Total Adjustments	-151	10775	-6563	-4905
Congressional program reductions				
Congressional rescissions		-200		
Congressional increases		11450		
Reprogrammings	-20	-79		
SBIR/STTR Transfer	-131	-396		
Adjustments to Budget Years			-6563	-4905

Change Summary Explanation:

Significant Changes:

FY 2004/2005: Funds realigned to PE 63125, Project DF1 to fund Base Camp Protection and Survivability requirements.

FY03 Congressional Adds:

DoD Fuel Cell Test and Evaluation Center, Project T13 (\$5950); Canola Oil Fuel Cell, Project T13 (\$1000); Solid Oxide Fuel Cell Development, Project T13 (\$4500).

Projects with no R2-As:

-\$11450 Stationary Fuel Cell Technologies, Project T13: The objective of these one year Congressional adds is to test, demonstrate and validate fuel cell systems for military and civil stationary power applications. Projects funded include the DoD Fuel Cell Test and Evaluation Center (\$5950); Canola Oil Fuel Cell (\$1000); and Solid Oxide Fuel Cell Development (\$4500).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603734A - Military Engineering Advanced Technology					PROJECT T08			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
T08 COMBAT ENG SYSTEMS	4554	2783	3441	3926	5448	6108	6256	6399	

A. Mission Description and Budget Item Justification: The objective of this project is to mature and demonstrate advanced military engineering technologies that support the Objective Force by improving capability to conduct logistics-over-the-shore (LOTS) operations in support of the Army's force projection goals. The inability to operate in rough seas and over soft beaches currently limits LOTS operations. A Rapidly Installed Breakwater (RIB) mitigates severe seas to permit off-loading ships, and mechanical reinforcement stabilizes the beach to permit traffic passage across the beach. Joint Rapid Airfield Construction (JRAC) technologies will support the expedient upgrading of existing airfields and rapid construction of new contingency airfields. Current construction technologies take too long. JRAC's terrain based site selection algorithms, computer assisted construction equipment, and fast curing soil stabilization chemical technologies support Army force projection goals. The time required to double the throughput of a minimal airfield will be reduced from four to two days. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center. This program supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds have been provided to the program.

<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
Enhanced Coastal Trafficability and Sea State Mitigation – In FY02, performed field demonstrations to include: fabrication of additional interchangeable RIB segments and mooring system; deployment of full-scale partial-length RIB and mooring system; and deployment/recovery of RIB by barge system.	4554	0	0	0
Joint Rapid Airfield Construction – In FY03, select promising new construction technologies to enhance airfield construction productivity and determine stabilizer technologies suitable for rapid stabilization of unsurfaced airfields. In FY04, demonstrate advanced airfield construction technologies for C-130 operations. In FY05, integrate advanced performance models and terrain data in airfield site selection.	0	2783	3441	3926
Totals	4554	2783	3441	3926

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603772A - Advanced Tactical Computer Science and Sensor Tech							
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Total Program Element (PE) Cost	15890	22153	20255	31565	52597	53665	36539	29895
101 TACTICAL AUTOMATION	12861	16318	15214	14313	19449	20852	21163	21191
1AA IMRSV PROGRAM FOR SIMULATION BASED OPERATION	0	1431	0	0	0	0	0	0
243 SENSORS & SIGNALS PROC	3029	4404	5041	17252	33148	32813	15376	8704

A. Mission Description and Budget Item Justification: This Program Element (PE) supports information dominance for the Army's Objective Force. To gain and maintain battlefield dominance, the Objective Force needs to understand, decide and act more rapidly than its adversaries. This PE will allow forces to more effectively collect, transfer and display digital information around the battlefield. It provides architectures and products to correct command and control (C2) deficiencies affecting rapid mobile, dispersed operations. It demonstrates technologies necessary for integrated battlefield situational awareness (SA), force synchronization, data correlation, tactical surveillance, and combat identification. Additionally, the technologies support split-based, on-the move (OTM) C2 operations, and multi-sensor payload for an A-160 class unmanned platform. The PE also addresses radar and signal processing. Technology solutions from this PE will be demonstrated in the Agile Commander Advanced Technology Demonstration (ATD) and the Logistics C2 (Log C2) ATD. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan.

Work in this PE is related to and fully coordinated with PE 0602783A (Computer and Software Technology), PE 0602782A (Command, Control and Communications Technology), and PE 0602120A (Sensors and Electronic Survivability). The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command (CECOM), Fort Monmouth, NJ. This program supports the Objective Force transition path outlined in the Transformation Campaign Plan.

No Defense Emergency Funds were provided to the program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603772A - Advanced Tactical Computer Science and Sensor Tech

<u>B. Program Change Summary</u>	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	16366	21674	21794	23159
Current Budget (FY 2004/2005 PB)	15890	22153	20255	31565
Total Adjustments	-476	479	-1539	8406
Congressional program reductions				
Congressional rescissions		-1645		
Congressional increases		2500		
Reprogrammings	-223	-127		
SBIR/STTR Transfer	-253	-249		
Adjustments to Budget Years			-1539	8406

Program Change Summary Explanation: Funding - FY 2005: Funds increased to support Mission Equipment Package for A-160 efforts.

FY03 Congressional Adds:

Automated Passive Propagation Sensor/Analyzer, Project 243 (\$1000); IMRSV Program for Simulation Based Operation, Project 1AA (\$1500).

Project with no R-2A:

(\$1500) IMRSV Program for Simulation Based Operation, Project 1AA: The objective of this one year Congressional add is to demonstrate technologies enabling simulation based operation. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603772A - Advanced Tactical Computer Science and Sensor Tech					PROJECT 101			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
101 TACTICAL AUTOMATION	12861	16318	15214	14313	19449	20852	21163	21191	

A. Mission Description and Budget Item Justification: This project provides improved command and control architectures and technologies for Objective Force information dominance. For the Army Objective 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 Objective 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 (S&T) solutions addressing: (1) digital transfer and display of horizontal battlefield situational awareness (SA) and a common view of the battlefield; (2) synchronization of combined and joint force operations; and (3) command and control (C2) on-the-move (OTM). It matures key technologies in the following areas: automated decision support; advanced database development and distribution; dynamic digital display and manipulation; web-based architectures for intelligent software agents and mission execution monitoring; and mobile adaptive computing. The Agile Commander ATD will demonstrate digital hardware and software technologies that provide agile, rapidly deployable, split-based C2 operation. The Logistics C2 ATD will mature course of action (COA) analysis and support software tools for combat service support and operational commanders. The Networked Sensors for the Objective Force ATD will demonstrate flexible C2 technologies to enable the commander of a Unit Cell to manage multiple unmanned air and ground platforms in a timely, effective manner. The Tactical Intelligence, Surveillance and Reconnaissance effort will demonstrate a common C2 and Intelligence database that provides the tactical commander a real-time, integrated Red and Blue forces picture with drill-down capability to the underlying intelligence sensor data. Joint developer/warfighter demonstrations will be conducted in coordination with the mounted, dismounted, battle command and combat service support battle labs. Products are transitioned to the Program Executive Offices for integration. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to the project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603772A - Advanced Tactical Computer Science and Sensor Tech	PROJECT 101
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
<p>- This effort matures and demonstrates technologies that enable distributed C2 while On-the-move. In FY02, demonstrated advanced COA generation software tools to support battle management and enable the commander to rapidly develop and compare courses of action in a collaborative environment that supports parallel planning at different echelons; integrated a model C2 and corresponding vehicle for a C4ISR on-the-move demonstration. Demonstrated logistics COA development and Class III and V COA analysis software and intelligent agents; demonstrated decision support software tools for combat commanders to plan crewing. In FY03, demonstrate COAA and wargaming capabilities and web-based intelligent agents for execution monitoring; and mature initial mobile adaptive computing software, integrate and demonstrate with scaleable communications capabilities to ensure C2 under varying operating conditions, both dispersed and while on-the-move. Participate in C4ISR On-The-Move testbed demonstrations; and mature and transition COA and decision support software to PM-CSSCS and automated data input software to PM-FBCB2. In FY04, demonstrate an increased capability of the C2 model to include execution monitoring of 300 events, tasking of sensors, the reception of a fused sensor data picture and the enabling of networked sensors and fires. In FY05, identify and mature C2 tools for the dismounted commander, from squad leader to unit cell commander, which enable dispersed, collaborative, real-time, on-the-move mission planning and updates through mission execution and analysis. Mature a set of web-based decision support and modeling and simulation tools for FCS and Army Objective Force commanders to collaboratively plan coalition activities in highly mobile operations, mature and demonstrate Army Objective Force manned and unmanned platform and weapons systems operational models and sustainment planning tools for combat service support.</p>	9997	13435	11834	11313
<p>Tactical Intelligence, Surveillance and Reconnaissance - In FY02, evolved performance requirements for a common C2 and intelligence database to provide tactical forces a real-time, integrated Red and Blue forces picture with the capability to drill down to the underlying sensor data, defined battlespace visualization requirements, and adapted COA tools to integrate C2, intelligence and resource allocation data to reduce workload of mission planners. In FY03, demonstrate an integrated common C2 and intelligence database, battlespace visualization products and COA development tools that provide tactical forces a real-time Red and Blue forces picture with drill down capability to underlying sensor data.</p>	2864	2883	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603772A - Advanced Tactical Computer Science and Sensor Tech	PROJECT 101
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<u>Accomplishments/Planned Program (continued)</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
- Networked Sensors for the Objective Force - In FY04, leverage, mature, integrate and demonstrate initial C2 tools for mission planning that provide C2 for tactical networked sensors through the management of unmanned platform assets; mature modeling and simulation capability and demonstrate C2 for networked sensors. In FY05, enhance and mature the C2 tools, conduct modeling and simulation to include unmanned weapons platforms, mature a model multi-echelon C2 that includes management of robotic sensor and weapons systems.	0	0	3380	3000
Totals	12861	16318	15214	14313

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603772A - Advanced Tactical Computer Science and Sensor Tech					PROJECT 243			
COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	
243 SENSORS & SIGNALS PROC	3029	4404	5041	17252	33148	32813	15376	8704	

A. Mission Description and Budget Item Justification: The Army needs a single multi-role sensor with sufficient mobility to support early entry forces or contingency theaters. A full complement of battlefield sensors cannot currently be expediently deployed. The Multi-Mission Radar (MMR) program will mature a Multi-mission HMMWV mounted radar (MMR) technology to support air defense, counter-battery, and air traffic control missions within a single system to enhance 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 Foliage Penetration Radar Program will provide the Warfighter an all weather airborne capability to detect and locate tactical targets employing camouflage and foliage as deceptive tactics. The goal of the Eye in the Sky (EIS) Program is to demonstrate multi-function, integrated sensor, including with 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 manned and tactical unmanned aerial vehicles (UAVs), such as the A-160, with wide area reconnaissance, surveillance and targeting capability in adverse weather. Synergistic operation of sensors with on-board sensor management, correlation of data for an integrated operational picture will be matured with significant leveraging of signal processing developments from industry, DARPA and other services. This project supports the Objective Force transition path of the Transformation Campaign Plan.

No Defense Emergency Response Funds were provided to this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

BUDGET ACTIVITY 3 - Advanced technology development	PE NUMBER AND TITLE 0603772A - Advanced Tactical Computer Science and Sensor Tech	PROJECT 243
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<u>Accomplishments/Planned Program</u>	FY 2002	FY 2003	FY 2004	FY 2005
- Multi-Mission Radar (MMR) and Foliage Penetrating Radar (FOPEN) - In FY02, matured and demonstrated high speed, high-throughput radar processors. Matured and demonstrated energy management for track-while-scan. Conducted verification test to evaluate the achieved performance and determined the readiness of FOPEN synthetic aperture radar (SAR) for participation in an operational demonstration. Demonstrated/validated the concept of operation to use the FOPEN SAR in support of potential users such as SOUTHCOM mission through testing performed at Camp McCain, MS and Appalochicola, FL. In FY03, mature software and hardware components for subsystem to include signal processor and software algorithm. In FY04, perform integration for software and algorithm for target classification, mission sorting and target queuing management. Perform hardware, software, and engineering test. In FY05, perform test with dedicated targets. Demonstrate efficient/lightweight transmitters and power supplies.	3029	3441	5041	11448
- Mission Equipment Package for A-160 - In FY05, mature limited integration of multi-sensor, eye-in-the sky payload for an A-160 class unmanned platform. Sensors include a medium range, high resolution SAR with moving target indicator capability, EO/IR sensor with commensurate range capability, and possible signals intelligence sensor. Mature integrated sensor architecture for automatic cross cueing of sensors and onboard data development.	0	0	0	5804
Automated Passive Propagation Sensor/Analyzer: The purpose of this one year congressional add is to demonstrate an automated weather data collection and measurement module that will be integrated into existing sensor systems. This information, along with target identification data, will be furnished in near real time to shooter for rapid, accurate targeting of threat systems. No additional funding is required.	0	963	0	0
Totals	3029	4404	5041	17252