UNCLASSIFIED

TOC

Supporting Data FY 2000/2001 Biennial Budget Estimate
Submitted to Congress - February 1999

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)

"READINESS THROUGH MODERNIZATION"

VOLUME I

UNCLASSIFIED

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS
OF THE
RESEARCH, DEVELOPMENT, TEST AND
EVALUATION, ARMY
FY 2000/2001
FEBRUARY 1999

VOLUME I
Budget Activities 1, 2 and 3

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

THIS PAGE INTENTIONALLY LEFT BLANK

FY 2000/2001 RDT&E, ARMY
PROGRAM ELEMENT DESCRIPTIVE SUMMARIES

INTRODUCTION AND EXPLANATION OF CONTENTS

1. General. This section has been prepared for the purpose of providing information concerning the Army Research, Development, Test and Evaluation 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 the FY 1998, 1999, 2000 and 2001 time period.

2. Relationship of the FY 2000 Budget Submission to the FY 1999 Budget submitted to Congress. This paragraph provides a list of program elements restructured, transitioned, or established to provide specific program identification.

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

OLD PE/PROJECT	NEW PROJECT TITLE	NEW PE/PROJECT
0203761A/399	Striker (Force XXI Initiative)	0203762A/008
0203761A/414	Radio Frequency Tags (RF Tags – Force XXI Initiative)	0203763A/007
0602618A/H81	Armor Exploratory Development	0602601A/C05
0603005A/C62	Combat Vehicle Survivability	0603005A/221
0603710A/K87	Night Vision Advanced Technology	0603710A/K70
0602710A/K87	Night Vision, ABN	0603710AK86
0603713A/370	Joint Tactical Radio System – Ground Domain Integration	0604805A/615
0604824A/112	COSSI	0708045A/E32
0604280A/152 (BA 3)	Joint Tactical Radio System	0604280A/162 (BA 5)

B. FY 2000 Developmental Transitions.

FROM PE/PROJECT	PROJECT TITLE	TO PE/PROJECT
0602303A/214	Advanced Missile Demos	0603313A/704
0602720A/896	Environmental Compliance Technology	0603728A/002
0603640A/B91 & 0603854A/C68	Crusader – Advanced Development	0603854A/505
0603804A/266/428 & 0604804A/279/429	Soldier Support Equipment – Advanced Development	0603747A/C09
0603805A/246	Tactical Communications System – Engineering Development	0604805A/629

C. Establishment of New FY 2000 Program Elements/Projects. There are no major system new starts. Minor new initiatives for FY 2000, in addition to Congressionally directed initiatives for FY 1999, are shown below with asterisks. Th remaining programs listed are outyear initiatives or restructures beyond FY 1999 or were previously funded from other Defens appropriations.

TITLE	PE/PROJECT
Emergency Preparedness Training	0203610A/E33
Striker (Force XXI Initiative)	0203762A/008
Radio Frequency Tags (RF Tags - Force XXI Initiative)	0203763A/007
Tactical Reconnaissance Sensors	0305206A/K98
Common Imagery Ground/Support Systems (CIGSS) Development	0305208A/956
Photonics Research	0602308A/D01
Sustaining Green Manufacturing	0602720A/947
Electronic Equipment Demanufacture*	0602720A/946
Army Research Office Chemical/Hazardous Material Disposal	0602720A/F27
Multimedia Tactical Adapter*	0602782A/J06
University Partnering for Operational Support	0602784A/T49
Enhanced Geographic Synthetic Aperature Radar (GeoSAR)*	0602784A/T50
Protable Cardiopulmonary Bypass	0602787A/948
Advanced Cancer Detection	0602787A/949

C. Establishment of New FY 2000 Program Elements/Projects - continued

TITLE	PE/PROJECT
Teleradiology	0602787A/950
Diagnostics and Surgical Breast Imaging	0602787A/951
Musculoskeletal Injuries*	0602787A/952
Disaster Relief and Emergency Medical Services (DREAMS)	0602787A/953
Telemedicine Testbed	0603002A/800
Digital X-Ray	0603002A/954
Assistive Technology	0603002A/955
Robotic Ground Systems	0603005A/515
Global Broadcast System (GBS) Information Management	0603006A/617
Tactical Simulation Interface Unit (TSIU)	0603308A/979
Range Upgrades	0603308A/988
Anti-Personnel Landmine Alternatives	0603606A/683
Millimeter Wave Technology	0603710A/K89
Joint Tactical Radio System – BA 5	0604280A/162
Trailer Development	0604622A/E50
Forward Repair System – Heavy	0604622A/E51
Digital Topographic Support System – WRAP	0604716A/653
Air and Missile Defense Planning and Control Support (PCS) – WRAP*	0604741A/169
Joint Tactical Radio Systems – Ground Domain Integration	0604805A/615
Tactical Communications System – Engineering Development	0604805A/629
Digital Information Technology Testbed	0605326A/309

D. FY 2000 programs for which funding was shown in the FY 1999 President's Budget Submit (February 1998), but which are no longer funded.

PE/PROJECT	TITLE	BRIEF EXPLANATION
0602308A/636	Army After Next (AAN) Applied Research	Program terminated
0602618A/H81	Armor/Anti-Armor Technology	Program restructured to 0602601A/C05
0602720A/895	Pollution Prevention	Program terminated
0603710A/K87	Night Vision, Combat Vehicl	Program restructured to 0603710A/K70/K86
0603780A/852	SERDP/Environmental Security Technology	Program transferred back to OSD

D. FY 2000 programs for which funding was shown in the FY 1999 President's Budget Submit (February 1998), but whic are no longer funded - Continued

PE/PROJECT	TITLE	BRIEF EXPLANATION
0603313A/496	Enhanced Fiber Optic Guided Missil (EFOG-M)	ATD Completed
0603645A/Q19	Future Combat System	Program terminated
0604325A/E18	Follow-On to TOW	Program terminated by Congress
0604768A/686	ATACMS Block II	Program restructured to the outyears.
0604804A/H02	Bridge Site Mobility	Program terminated
0605853A	Environmental Conservation	Program transferred to OMA PE 0408853
0605854A	Pollution Prevention	Program transferred to OMA PE 0408854
0605856A	Environmental Complianc	Program transferred to OMA PE 0408856
0605876A	Minor Construction – RPM	Program transferred to OMA PE 0409876
0605878A	Maintenance and Repair – RPM	Program transferred to OMA PE 0409878
0605879A	Real Property (RPS)	Program transferred to OMA PE 0408879
0605896A	Base Operations – RDTE	Program transferred to OMA PE 0408896
0203735A/718	Ground Combat Vehicle HTI	Program terminated

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

0203735A/DC64	0603005A/DC62/DC66	0603851A
0203808A	0603009A	0603854A/DC68
0301359A	0603020A	0604649A/DG15
0602104A	0603017A	0604328A
0602122A	0603018A	
0602712A/AC61	0603122A	
0602786A/AC60	0603322A	
0603003A/D391	0603710A/DC63/DC65/ DC67	

Department of the Army
FY 2000/2001 RDT&E Program

Exhibit R-1

Summary

Date: Feb 1999

Thousands of Dollars

Summary Recap of Budget Activities	FY 1998	FY 1999	FY 2000	FY 2001
Basic Research	177,269	183,727	186,872	191,101
Applied Research	663,035	628,091	555,258	563,386
Advanced Technology Development	677,814	653,024	524,925	494,101
Demonstration and Validation	536,628	497,598	405,723	281,322
Engineering and Manufacturing Development	1,130,519	1,267,285	1,495,741	1,893,978
RDT&E Management Support	1,216,038	1,136,691	665,304	739,807
Operational Systems Development	622,010	665,782	592,371	586,883
Total Research Development Test & Eval Army	5,023,313	5,032,198	4,426,194	4,750,578

THIS PAGE INTENTIONALLY LEFT BLANK

Department of the Army
FY 2000/2001 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Research Development Test & Eval Army

Date: Feb 1999

Line No	Program Element Number	Item	Act	FY 1998	FY 1999	FY 2000	FY 2001
				Thousands of Dollars			
1	0601101A	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	1	13,325	13,574	14,193	14,499
2	0601102A	DEFENSE RESEARCH SCIENCES	1	120,211	125,314	125,613	128,578
3	0601104A	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	1	43,733	44,839	47,066	48,024
	Basic Research			177,269	183,727	186,872	191,101
4	0602104A	TRACTOR ROSE	2	0	0	6,766	6,667
5	0602105A	MATERIALS TECHNOLOGY	2	12,319	13,012	13,849	13,825
6	0602120A	SENSORS AND ELECTRONIC SURVIVABILITY	2	25,545	16,614	22,978	23,723
7	0602122A	TRACTOR HIP	2	6,872	11,603	9,298	7,191
8	0602211A	AVIATION TECHNOLOGY	2	22,698	24,943	30,165	31,184
9	0602270A	EW TECHNOLOGY	2	15,927	16,116	17,487	18,082
10	0602303A	MISSILE TECHNOLOGY	2	22,199	30,130	32,892	31,469
11	0602308A	ADVANCED CONCEPTS AND SIMULATION	2	19,660	21,494	24,955	24,799
12	0602601A	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	2	62,141	39,208	39,749	41,625
13	0602618A	BALLISTICS TECHNOLOGY	2	36,678	27,229	36,287	37,687
14	0602622A	CHEMICAL, SMOKE AND EQUIP DEFEATING TECHNOLOG	2	3,500	5,078	3,996	4,042
15	0602623A	JOINT SERVICE SMALL ARMS PROGRAM	2	8,714	5,188	5,187	5,428
16	0602624A	WEAPONS AND MUNITIONS TECHNOLOGY	2	27,962	28,913	34,687	37,487
17	0602705A	ELECTRONICS AND ELECTRONIC DEVICES	2	23,974	25,238	25,796	27,719
18	0602709A	NIGHT VISION TECHNOLOGY	2	16,563	19,008	20,111	20,966
19	0602712A	COUNTERMINE SYSTEMS DEVELOPMENT	2	9,928	10,547	10,321	10,453
20	0602716A	HUMAN FACTORS ENGINEERING TECHNOLOGY	2	16,577	16,473	16,392	16,270
21	0602720A	ENVIRONMENTAL QUALITY TECHNOLOGY	2	58,711	64,386	12,758	14,041
22	0602782A	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	2	16,197	22,359	19,613	21,010
23	0602783A	COMPUTER AND SOFTWARE TECHNOLOGY	2	658	2,170	5,210	4,012
24	0602784A	MILITARY ENGINEERING TECHNOLOGY	2	55,978	52,074	41,085	42,820
25	0602785A	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	2	10,736	8,533	12,071	11,904
26	0602786A	WARFIGHTER TECHNOLOGY	2	17,372	18,420	23,971	23,405
27	0602787A	MEDICAL TECHNOLOGY	2	171,362	138,264	70,136	68,014
28	0602789A	ARMY ARTIFICIAL INTELLIGENCE TECHNOLOGY	2	764	1,156	1,276	1,346
29	0602805A	DUAL USE APPLICATIONS PROGRAM	2	0	9,935	18,222	18,217
	Applied Research			663,035	628,091	555,258	563,386

Department of the Army
FY 2000/2001 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Research Development Test & Eval Army

Date: Feb 1999

Line No	Program Element Number	Item	Act	FY 1998	FY 1999	FY 2000	FY 2001
				Thousands of Dollars			
30	0603001A	WARFIGHTER ADVANCED TECHNOLOGY	3	33,126	30,430	31,287	16,337
31	0603002A	MEDICAL ADVANCED TECHNOLOGY	3	202,504	229,325	10,539	12,591
32	0603003A	AVIATION ADVANCED TECHNOLOGY	3	85,778	44,834	34,167	38,585
33	0603004A	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	3	23,694	24,858	39,893	38,686
34	0603005A	COMBAT VEHICLE AND AUTOMATIVE ADVANCED TECH	3	38,694	61,300	90,941	97,200
35	0603006A	COMMAND, CONTROL, COMM ADVANCED TECHNOLOGY	3	24,884	23,747	20,883	21,508
36	0603007A	MANPOWER, PERSONNEL AND TRAINING ADV TECH	3	3,913	2,949	3,030	3,074
37	0603009A	TRACTOR HIKE	3	13,901	9,807	12,553	13,537
38	0603013A	TRACTOR DIRT	3	3,178	48	0	0
39	0603017A	TRACTOR RED	3	5,190	4,559	4,582	2,830
40	0603020A	TRACTOR ROSE	3	10,379	2,001	11,151	10,950
41	0603105A	MILITARY HIV RESEARCH	3	17,541	5,672	5,976	5,926
42	0603122A	TRACTOR HIP	3	0	0	2,432	986
43	0603238A	AIR DEFENSE/PRECISION STRIKE TECHNOLOGY	3	12,174	9,907	24,618	21,434
44	0603270A	EW TECHNOLOGY	3	7,672	11,425	16,169	17,008
45	0603313A	MISSILE AND ROCKET ADVANCED TECHNOLOGY	3	91,280	71,394	43,639	24,011
46	0603322A	TRACTOR GEM	3	5,758	4,377	2,665	3,083
47	0603606A	LANDMINE WARFARE AND BARRIER ADV TECHNOLOGY	3	30,529	23,777	47,456	44,935
48	0603607A	JOINT SERVICE SMALL ARMS PROGRAM	3	8,784	9,608	4,869	5,468
49	0603654A	LINE-OF-SIGHT TECHNOLOGY DEMO	3	4,683	11,920	41,619	52,940
50	0603710A	NIGHT VISION ADVANCED TECHNOLOGY	3	17,628	27,273	36,628	37,035
51	0603728A	ENVIRONMENTAL QUALITY TECHNOLOGY DEVELOPMENT	3	0	0	1,337	1,626
52	0603734A	MILITARY ENGINEERING ADVANCED TECHNOLOGY	3	18,922	15,523	15,881	5,240
53	0603772A	ADV TACTICAL COMPUTER SCIENCE & SENSOR TECH	3	17,602	18,257	22,610	19,111
54	0604280A	JOINT TACTICAL RADIO SYSTEM	3	0	10,033	0	0
		Advanced Technology Development		677,814	653,024	524,925	494,101
55	0603308A	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION	4	72,009	38,957	12,353	12,580
56	0603619A	LANDMINE WARFARE AND BARRIER - ADV DEV	4	14,845	6,707	4,099	19,832
57	0603639A	ARMAMENT ENHANCEMENT INITIATIVE	4	36,036	35,784	36,937	42,511
58	0603640A	ARTILLERY PROPELLANT DEVELOPMENT	4	7,983	0	0	0
59	0603645A	ARMORED SYSTEMS MODERNIZATION-ADVANCED DEVEL	4	1,130	0	0	0
60	0603653A	ADVANCED TANK ARMAMENT SYSTEM	4	8,485	8,867	1,937	8,870
61	0603713A	ARMY DATA DISTRIBUTION SYSTEM	4	19,785	15,162	10	17

Department of the Army
FY 2000/2001 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Research Development Test & Eval Army

Date: Feb 1999

Line No	Program Element Number	Item	Act	FY 1998	FY 1999	FY 2000	FY 2001
				Thousands of Dollars			
		x					
62	0603747A	SOLDIER SUPPORT AND SURVIVABILITY	4	6,196	7,522	12,804	13,642
63	0603766A	TAC EXPLOIT OF NAT CAP (TENCAP)-DEM/VAL TIARA	4	18,957	0	0	0
64	0603774A	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT	4	2,152	2,664	3,188	4,036
65	0603790A	NATO RESEARCH AND DEVELOPMENT (H)	4	7,885	4,132	1,872	1,971
66	0603801A	AVIATION - ADV DEV	4	14,869	11,404	5,746	5,870
67	0603802A	WEAPONS AND MUNITIONS - ADV DEV	4	0	0	1,751	2,810
68	0603804A	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	4	6,570	18,845	6,514	6,265
69	0603805A	CBT SERVICE SUPPORT CONTROL SYS EVAL & ANALYS	4	7,037	14,056	11,062	8,839
70	0603807A	MEDICAL SYSTEMS - ADV DEV	4	9,181	11,329	12,723	12,235
71	0603851A	TRACTOR EARL	4	1,779	960	1,087	985
72	0603854A	ARTILLERY SYSTEMS DEMONSTRATION/VALIDATION	4	301,160	313,526	282,937	120,457
73	0603856A	SCAMP BLOCK II (SPACE)	4	569	7,683	10,703	20,402
		Demonstration and Validation		536,628	497,598	405,723	281,322
74	0604201A	AIRCRAFT AVIONICS	5	32,504	14,780	6,372	2,990
75	0604223A	COMANCHE	5	262,601	364,784	427,069	565,800
76	0604270A	EW DEVELOPMENT	5	84,106	86,258	78,603	81,037
77	0604280A	JOINT TACTICAL RADIO SYSTEM	5	0	0	36,797	68,296
78	0604321A	ALL SOURCE ANALYSIS SYSTEM	5	25,275	33,776	49,684	46,399
79	0604325A	FOLLOW-ON TO TOW	5	9,002	0	0	0
80	0604328A	TRACTOR EARL	5	11	1,777	2,848	2,934
81	0604601A	INFANTRY SUPPORT WEAPONS	5	0	0	0	1,747
82	0604604A	MEDIUM TACTICAL VEHICLES	5	2,917	0	1,973	1,971
83	0604609A	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ED	5	0	701	918	2,480
84	0604611A	JAVELIN (AWWS-M)	5	7,512	5,242	493	493
85	0604619A	LANDMINE WARFARE	5	21,448	23,036	13,318	0
86	0604622A	FAMILY OF HEAVY TACTICAL VEHICLES	5	4,683	8,244	0	0
87	0604633A	AIR TRAFFIC CONTROL	5	6,750	1,724	1,981	2,035
88	0604640A	ADVANCED COMMAND AND CONTROL VEHICLE	5	9,382	0	0	0
89	0604641A	TACTICAL UNMANNED GROUND VEHICLE	5	2,397	2,452	0	0
90	0604642A	LIGHT TACTICLE WHEELED VEHICLE	5	0	0	7,498	9,954
91	0604645A	ARMORED SYSTEMS MODERNIZATION (ASM)-ENG DEV	5	0	4,470	2,899	6,064
92	0604649A	ENGINEER MOBILITY EQUIPMENT DEVELOPMENT	5	52,388	70,590	58,321	37,741

Department of the Army
FY 2000/2001 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Research Development Test & Eval Army

Date: Feb 1999

Line No	Program Element Number	Item	Act	FY 1998	FY 1999	FY 2000	FY 2001
				Thousands of Dollars			
93	0604710A	NIGHT VISION SYSTEMS - ENG DEV	5	33,338	21,167	30,644	31,270
94	0604713A	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	5	58,579	67,674	110,829	136,899
95	0604715A	NON-SYSTEM TRAINING DEVICES - ENG DEV	5	75,977	63,778	71,034	51,925
96	0604716A	TERRAIN INFORMATION - ENG DEV	5	2,831	6,157	5,348	6,120
97	0604726A	INTEGRATED METEOROLOGICAL SUPPORT SYSTEM	5	1,823	1,777	2,318	1,782
98	0604739A	JTT/CIBS-M (TIARA)	5	4,215	4,400	4,552	6,096
99	0604741A	AIR DEFENSE C2I - ENG DEV	5	20,591	11,458	7,995	8,942
100	0604746A	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	5	7,925	9,962	10,252	12,632
101	0604760A	DISTRIBUTIVE INTERACTIVE SIMULATIONS ENG DEV	5	19,572	2,727	7,657	20,646
102	0604766A	TAC EXPLOIT NAT CAP (TENCAP)-EMD (TIARA)	5	17,221	43,950	70,940	57,008
103	0604768A	BRILLIANT ANTI-ARMOR SUBMUNITION(BAT)	5	225,241	128,521	128,026	112,149
104	0604770A	JOINT SURVEILLANCE/TARGET ATTACK RADAR SYSTEM	5	6,464	5,463	11,535	26,871
105	0604778A	POSITIONING SYS DEVEL (SPACE)	5	405	377	443	435
106	0604780A	COMBINED ARMS TACTICAL TRAINER (CATT)	5	14,950	7,472	19,925	18,627
107	0604801A	AVIATION - ENG DEV	5	5,402	11,519	6,312	9,264
108	0604802A	WEAPONS AND MUNITIONS - ENG DEV	5	18,114	35,566	54,943	55,077
109	0604804A	LOGISTICS & ENGINEER EQUIPMENT - ENG DEV	5	21,591	25,820	22,996	16,074
110	0604805A	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ED	5	14,352	16,280	23,987	23,842
111	0604807A	MEDICAL MATERIEL/MED BIO DEFENSE EQUIPMENT ED	5	4,200	5,299	9,705	9,448
112	0604808A	LANDMINE WARFARE/BARRIER - ENG DEV	5	4,040	52,680	40,916	39,187
113	0604814A	SENSE AND DESTROY ARMOR - ENG DEV	5	10,485	31,602	19,366	9,775
114	0604817A	COMBAT IDENTIFICATION	5	19,227	13,379	8,658	2,395
115	0604818A	ARMY TACTICAL COMM & CONT HARDWARE & SOFTWARE	5	20,600	32,548	35,299	33,620
116	0604820A	RADAR DEVELOPMENT	5	0	6,742	5,128	8,481
117	0604823A	FIREFINDER	5	2,400	20,583	32,353	37,589
118	0604824A	COSSI	5	0	21,457	0	0
119	0604854A	ARTILLERY SYSTEMS - ENGINEERING DEVELOPMENT	5	0	1,093	65,806	327,883
		Engineering and Manufacturing Development		1,130,519	1,267,285	1,495,741	1,893,978
120	0604256A	THREAT SIMULATOR DEVELOPMENT	6	15,501	12,837	13,680	13,791
121	0604258A	TARGET SYSTEMS DEVELOPMENT	6	11,149	13,038	13,397	14,423
122	0604759A	MAJOR TEST & EVALUATION INVESTMENT	6	40,256	37,030	39,380	40,190
123	0605103A	RAND ARROYO CENTER	6	15,983	16,685	17,656	17,995

Department of the Army
FY 2000/2001 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Research Development Test & Eval Army

Date: Feb 1999

Line No	Program Element Number	Item	Act	FY 1998	FY 1999	FY 2000	FY 2001
				Thousands of Dollars			
124	0605301A	ARMY KWAJALEIN ATOLL	6	117,096	133,027	140,344	140,958
125	0605326A	CONCEPTS EXPERIMENTATION	6	0	13,948	16,990	73,006
		xii					
126	0605502A	SMALL BUS INV RSCH/SMALL BUS TECH PILOT PROG	6	106,048	0	0	0
127	0605601A	ARMY TEST RANGES AND FACILITIES	6	114,970	118,571	137,193	134,335
128	0605602A	ARMY TECHNOLOGY & SUSTAINING INSTRUMENTATION	6	30,518	43,638	30,470	33,332
129	0605604A	SURVIVABILITY/LETHALITY ANALYSIS	6	30,263	34,131	30,138	33,916
130	0605605A	DOD HIGH ENERGY LASER SYS TEST FAC (HELSTF)	6	28,048	23,848	14,230	14,260
131	0605606A	AIRCRAFT CERTIFICATION	6	2,734	2,893	3,021	3,169
132	0605702A	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	6	6,235	6,628	6,843	6,952
133	0605706A	MATERIEL SYSTEMS ANALYSIS	6	27,120	9,617	8,796	8,718
134	0605709A	EXPLOITATION OF FOREIGN ITEMS	6	7,277	4,004	4,143	3,605
135	0605712A	SUPPORT OF OPERATIONAL TESTING	6	74,656	65,460	68,946	69,038
136	0605716A	ARMY EVALUATION CENTER	6	0	25,313	24,255	26,362
137	0605801A	PROGRAMWIDE ACTIVITIES	6	79,128	64,047	64,121	73,259
138	0605803A	TECHNICAL INFORMATION ACTIVITIES	6	15,795	16,006	15,973	16,330
139	0605805A	MUNITIONS STANDARDZION EFFECTIVENESS & SAFETY	6	10,707	10,422	10,537	10,814
140	0605853A	ENVIRONMENTAL CONSERVATION	6	2,435	3,174	0	0
141	0605854A	POLLUTION PREVENTION	6	4,773	10,624	0	0
142	0605856A	ENVIRONMENTAL COMPLIANCE-RDT&E	6	55,058	48,986	0	0
143	0605876A	MINOR CONSTUCTION (RPM) - RDTE	6	4,003	4,177	0	0
144	0605878A	MAINTENANCE AND REPAIR (RPM) - RDTE	6	79,639	80,059	0	0
145	0605879A	REAL PROPERTY SERVICES (RPS)	6	84,756	86,441	0	0
146	0605896A	BASE OPERATIONS-RDT&E	6	224,968	229,573	0	0
147	0605898A	MANAGEMENT HEADQUARTERS (RSCH & DEVELOPMENT)	6	24,361	22,514	5,191	5,354
148	0909999A	CLOSED ACCOUNT ADJUSTMENT	6	2,561	0	0	0
		RDT&E Management Support		1,216,038	1,136,691	665,304	739,807
149	0603778A	MLRS PRODUCT IMPROVEMENT PROGRAM	7	33,022	25,159	36,540	58,591
150	0102419A	JOINT LAND ATTACK CRUISE MISSILE DEFENSE (JLENS)	7	29,910	14,572	24,903	25,141
151	0203610A	EMERGENCY PREPAREDNESS TRAINING	7	0	15,000	0	0
152	0203726A	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	7	36,225	34,646	36,222	34,528
153	0203735A	COMBAT VEHICLE IMPROVEMENT PROGRAMS	7	151,520	104,000	29,544	23,938
154	0203740A	MANEUVER CONTROL SYSTEM	7	23,712	28,623	45,125	25,682

Department of the Army
FY 2000/2001 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Research Development Test & Eval Army

Date: Feb 1999

Line No	Program Element Number	Item	Act	FY 1998	FY 1999	FY 2000	FY 2001
				Thousands of Dollars			
155	0203744A	AIRCRAFT MODIFICATIONS/PRODUCT IMPROV PROGRAM	7	21,847	26,628	51,644	61,033
156	0203752A	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	7	2,756	6,901	2,900	2,946
157	0203758A	DIGITIZATION	7	91,248	46,240	28,180	26,830
158	0203759A	FORCE XXI BATTLE CMD, BRIGADE & BELOW	7	0	52,121	44,225	28,876
159	0203761A	FORCE XXI WARFIGHTING RAPID ACQUISITION PGM	7	8,686	26,942	55,921	66,058
160	0203762A	STRIKER (WRAP)	7	3,654	0	0	0
161	0203763A	RADIO FREQUENCY TECHNOLOGY	7	1,592	0	0	0
162	0203801A	MISSILE/AIR DEFENSE PRODUCT IMPRV PROGRAM	7	29,471	15,151	29,985	28,649
163	0203802A	OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS	7	1,613	1,239	9,914	14,817
164	0203806A	TRACTOR RUT	7	1,967	0	0	0
165	0203808A	TRACTOR CARD	7	6,146	3,967	3,898	3,861
166	0208010A	JOINT TACTICAL COMMUNICATIONS PROG (TRI-TAC)	7	20,815	35,664	18,432	19,666
167	0208053A	JOINT TACTICAL GRD STATION (TIARA)	7	4,835	12,148	28,061	6,306
168	0301359A	SPECIAL ARMY PROGRAM	7	10,543	9,704	6,584	5,471
169	0303140A	INFORMATION SYSTEMS SECURITY PROGRAM	7	11,406	11,338	9,426	8,178
170	0303142A	SATCOM GROUND ENVIRO (SPACE)	7	45,679	52,447	36,230	47,743
171	0303150A	ARMY GLOBAL C2 SYS	7	14,094	17,339	11,606	14,295
172	0305114A	TRAFFIC CNTL/APPROACH/LANDING SYS (JPALS)	7	610	0	0	788
173	0305128A	SECURITY AND INTELLIGENCE ACTIVITIES	7	468	944	0	0
174	0305204A	TACTICAL UNMANNED AERIAL VEHICLE	7	0	53,224	3,866	4,309
175	0305206A	AIRBORNE RECONNAISSANCE ADVANCED DEVELOPMENT	7	0	7,451	4,932	4,928
176	0305208A	DISTRIBUTED COMMON GROUND SYSTEMS	7	0	8,853	8,066	7,943
177	0708045A	MANUFACTURING TECHNOLOGY	7	60,044	52,501	66,167	66,306
178	1001018A	NATO JSTARS - TIARA	7	10,147	2,980	0	0
		Operational Systems Development		622,010	665,782	592,371	586,883
Total Research Development Test & Eval Army				5,023,313	5,032,198	4,426,194	4,750,578

TABLE OF CONTENTS

Introduction & Explanation

Summary **Appropriation**

Appendix A

TABLE OF CONTENTS

TABLE OF CONTENTS

Volume II

TABLE OF CONTENTS

PE **PROGRAM ELEMENT TITLE** **PAGE**

Volume II

TABLE OF CONTENTS

Volume II

TABLE OF CONTENTS

Volume II

Volume III

TABLE OF CONTENTS

Volume III

TABLE OF CONTENTS

Volume III

TABLE OF CONTENTS

Volume III

ALPHABETICAL LISTING

ALPHABETICAL LISTING

ALPHABETICAL LISTING

ALPHABETICAL LISTING

ALPHABETICAL LISTING

ALPHABETICAL LISTING

ALPHABETICAL LISTING

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	13325	13574	14193	14499	14829	16722	17530	18164	Continuing	Continuing
A91A In-House Laboratory Independent Research - Army Materiel Command	8672	9327	9807	10043	10301	11190	11634	12092	Continuing	Continuing
A91C In-House Laboratory Independent Research - Medical Research and Materiel Command	3769	3548	3665	3724	3784	4495	4846	4985	Continuing	Continuing
A91D In-House Laboratory Independent Research - Corps of Engineers	884	699	721	732	744	1037	1050	1087	Continuing	Continuing

A. Mission Description and Budget Item Justification: In-House Laboratory Independent Research (ILIR) 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 senior researchers as well as the most promising, developing scientists. The ILIR funding allocation is based on the quality of past performance. Each year, ILIR project reports are submitted from competing Army research organizations to the Office of the Assistant Secretary of Army (Research, Development, and Acquisition). These ILIR reports are subjected to a strenuous technical peer review by a review committee composed of leading scientists and engineers from the National Academy of Sciences, the Army Science Board, and Army Secretariat. ILIR funding allocation for the subsequent year is based on the score assessed by the ILIR review committee. Successful ILIR projects are typically transitioned to start-up projects under 6.1 or 6.2 mission funding within the organization. Since its establishment by DoD Directive number 3201.4, dated October 8, 1993, the Army's ILIR program has supported and will continue to promote the 1987 Defense Science Board Study on Technology Base Management's recommendation to attract and retain top flight science and engineering PhDs.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	13678	14902	15726	16124
Appropriated Value	14113	13678		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-435	-104		
b. SBIR / STTR	-226			
c. Omnibus or Other Above Threshold Reductions	-75			
d. Below Threshold Reprogramming	-52			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-1533	-1625
Current Budget Submit (FY 2000 / 2001 PB)	13325	13574	14193	14499

Change Summary Explanation: FY99 Congressional committee language indicates likelihood that Congress will act to reduce 6.1 program growth. Congress reduced this PE in FY 1999 (-1224). FY 2000/2001 was adjusted accordingly.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: A91A

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A91A In-House Laboratory Independent Research - Army Materiel Command	8672	9327	9807	10043	10301	11190	11634	12092	Continuing	Continuing

Mission Description and Justification: This project provides funding for ILIR research, allocated among the seven Research, Development and Engineering Centers (RDECs) in the Army Materiel Command (AMC).

FY 1998 Accomplishments:

- 8672 - Missile RDEC -Conducted research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities.
  - Armaments RDEC -Evaluated unique phenomena in weapons and munitions related research, focusing on gun/cannon barrel erosion prevention and energetic materials for various weaponry applications.
  - Tank-Automotive RDEC -Developed an improved understanding of advanced diesel engine technology through nonlinear models of compliant structures, heat transfer mechanisms for cold start engine phenomena, and non-invasive thermal imaging of engine combustion phenomena.
  - Natick RDEC -Identified innovative technologies in the areas of molecular biology, biopolymers and modeling of personnel equipment characteristics.
  - Edgewood RDEC -Investigated innovative approaches to pathogen detection including development of DNA super libraries and genome sequencing of pathogens; begin development of respirator encumbrance model for the individual soldier.
  - Aviation RDEC -Demonstrated a new rapid, non-intrusive velocity measurement technique, Doppler Global Velocimetry, for measuring rotorcraft 3D flow fields.
  - Communications-Electronics RDEC -Developed antenna and sensor technologies and computer models; improved intelligence data fusion techniques; upgraded sensor simulation/performance models.

Total 8672

FY 1999 Planned Program:

- 9170 - Missile RDEC - Continue research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities; demonstrate and transition components and concepts.
  - Armaments RDEC -Evaluate micro-electro mechanical systems (MEMS) technology for low-cost projectile guidance and control; continue investigations into real-time material characterizations and advanced energetic materials.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601101A In-House Laboratory Independent Research**
	PROJECT **A91A**

FY 1999 Planned Program: (continued)

- Tank-Automotive RDEC -Correlate ignition delays with combustion temperature and pressure profiles; automate multibody dynamic systems modeling using algebraic constraints; calculate 3-D stress distributions in thick composite materials.
- Natick RDEC -Validate models of materials/fabric/food constituents against known parameters, transfer results to core basic research and applied research programs in ration and clothing research.
- Edgewood RDEC -Initiate project to prove concept for virus detectors. Begin construction of data reduction/analysis algorithms needed for the development of a satellite/high altitude chemical imaging sensor.
- Aviation RDEC -Investigate application of "smart materials" and/or micro-electro mechanical systems (MEMS) for alleviation of dynamic stall to improve rotor aerodynamics.
- Communications-Electronics RDEC -Upgrade battlefield visualization tools; transition antenna technologies; improve power sources technology, advance sensor technology base.

•	157	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	9327	

FY 2000 Planned Program:

•	9807	- Missile RDEC - Conduct research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities; demonstrate and transition components and concepts. Armaments RDEC -Evaluate micro-electro mechanical systems (MEMS) technology for low-cost projectile guidance and control; continue investigations into real-time material characterizations and advanced energetic materials. Tank-Automotive RDEC –Continue research to correlate ignition delays with combustion temperature and pressure profiles; automate multibody dynamic systems modeling using algebraic constraints; calculate 3-D stress distributions in thick composite materials. - Natick RDEC –Develop new models of materials/fabric/food constituents against known parameters, transfer results to core basic research and applied research programs in ration and clothing research. - Edgewood RDEC – Conduct research to prove concept for a specific virus detector. Begin construction of data reduction/analysis algorithms needed for the development of a satellite/high altitude chemical imaging sensor. - Aviation RDEC –Continue investigation of "smart materials" and/or micro-electro mechanical systems (MEMS) for alleviation of dynamic stall to improve rotor aerodynamics. - Communications-Electronics RDEC -Transition antenna technologies; improve power sources technology, advance sensor technology base.
Total	9807	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601101A In-House Laboratory Independent Research**
	PROJECT **A91A**

FY 2001 Planned Program:

•	10043	- Missile RDEC - Conduct research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities; demonstrate and transition components and concepts. Armaments RDEC –Continue evaluation micro-electro mechanical systems (MEMS) technology for low-cost projectile guidance and control; continue investigations into real-time material characterizations and advanced energetic materials. Tank-Automotive RDEC –Validate research on ignition delays with combustion temperature and pressure profiles; automate multibody dynamic systems modeling using algebraic constraints; calculate 3-D stress distributions in thick composite materials. - Natick RDEC -Validate models of materials/fabric/food constituents against known parameters, transfer results to core basic research and applied research programs in ration and clothing research. - Edgewood RDEC –Conduct research for a specific virus detector based on previously validated concepts. Continue construction of data reduction/analysis algorithms needed for the development of a satellite/high altitude chemical imaging sensor. - Aviation RDEC –Validate concepts for "smart materials" and/or micro-electro mechanical systems (MEMS) for alleviation of dynamic stall to improve rotor aerodynamics. - Communications-Electronics RDEC -Upgrade battlefield visualization tools; Continue to transition antenna technologies; improve power sources technology, advance sensor technology base.
Total	10043	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: A91C

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A91C In-House Laboratory Independent Research - Medical Research and Materiel Command	3769	3548	3665	3724	3784	4495	4846	4985	Continuing	Continuing

Mission Description and Justification: Represents funds to conduct ILIR research allocated among the six laboratories of the Medical Research and Materiel Command, including the Aeromedical Research Laboratory, the Institute of Surgical Research, the Institute of Environmental Medicine, the Medical Institute of Chemical Defense, the Medical Institute of Infectious Diseases and Walter Reed Army Institute of Research.

FY 1998 Accomplishments:

- 3769 - Devised Polymerase Chain reaction (PCR) tests for the diagnosis of scrub typhus and brucellosis.
  - Demonstrated the feasibility in a mouse model of immunizing against VEE by the nasal mucosal route.
  - Demonstrated the potential of DNA plasmids containing genes for Ebola virus glycoproteins to immunized mice.
  - Developed the software and computer network architecture that successfully integrated the physiological heat strain model into a real-time remote weather sensing system.
  - Developed a model of hemorrhage to evaluate resuscitation simulation care on the battlefield.
  - Developed a reproducible model in rabbits to determine the effects of renal occlusion and hemorrhage and of resuscitation parameters.

Total 3769

FY 1999 Planned Program:

- 3455 - Continue research for medical countermeasures against naturally occurring infectious diseases which can have significant impacts on military operations to protect the force from infection and sustain operations.
  - Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness.
  - Continue research to understand the basic mechanisms of combat related trauma, identifying innovative treatment and surgical procedures to extend the time of death due to loss of blood and organ failure ("golden hour") following trauma.
- 93 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3548

FY 2000 Planned Program:

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601101A In-House Laboratory Independent Research
	PROJECT A91C

- 3665 - Continue research for medical countermeasures against naturally occurring infectious diseases which can have significant impacts on military operations to protect the force from infection and sustain operations.

FY 2000 Planned Program: (continued)

- Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness.
- Continue research to understand the basic mechanisms of combat related trauma, identifying innovative treatment and surgical procedures to extend the “golden hour” following trauma.

Total 3665

FY 2001 Planned Program:

- 3724 - Continue research for medical countermeasures against naturally occurring infectious diseases which can have significant impacts on military operations to protect the force from infection and sustain operations.
- Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness.
- Continue research to understand the basic mechanisms of combat related trauma, identifying innovative treatment and surgical procedures to extend the “golden hour” following trauma.

Total 3724

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: A91D

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A91D In-House Laboratory Independent Research - Corps of Engineers	884	699	721	732	744	1037	1050	1087	Continuing	Continuing

Mission Description and Justification: Represents funds to conduct ILIR research allocated among the four laboratories within the Army Corps of Engineers, including the Topographic Engineering Center, the Waterways Experimental Station, the Construction Engineering Research Laboratories and the Cold Regions Research and Engineering Laboratory.

FY 1998 Accomplishments:

- 884 - Conducted research in the terrain representation process and terrain data generation by sponsoring related topics in these areas at the Topographic Engineering Center.
  - Determined in vitro molecular and cellular toxicity of common/fielded explosives to establish biomarkers of exposure at the Waterways Experimental Station.
  - Developed simplified, parameter-insensitive, sensorless machine control techniques at the Construction Engineering Research Laboratories.
  - Explored physics-based correlations between mechanical and electrical properties of sea ice as a basis for translation of satellite sensor data to physical behavior and examined means to characterize the diffusion of various chemical species through frozen soils and permafrost at the Cold Region Research and Engineering Laboratory.

Total 884

FY 1999 Planned Program:

- 681 - Exploit image statistics from multi-scale transforms for extraction of topographic information from imagery.
  - Investigate the feasibility of shaft sensorless control systems capable of determining the vibration characteristics of rotating machine technology.
  - Develop hyperspectral approach for snow cover property assessment.
  - Develop transport mechanisms (including chemical interactions) of contaminants through porous media at micropore scale.
- 18 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 699

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601101A In-House Laboratory Independent Research**
	PROJECT **A91D**

FY 2000 Planned Program:

•	721	- Continue to exploit image statistics from multi-scale transforms for extraction of topographic information from imagery. - Demonstrate the feasibility of shaft sensorless control systems capable of determining the vibration characteristics of rotating machine technology. - Evaluate hyperspectral approach for snow cover property assessment. - Evaluate alternative transport mechanisms (including chemical interactions) of contaminants through porous media at micropore scale.
Total	721	

FY 2001 Planned Program:

•	732	- Transition techniques developed from image statistics from multi-scale transforms for extraction of topographic information from imagery. - Transition shaft sensorless control systems technology to determine the vibration characteristics of rotating machines. - Validate hyperspectral approach for snow cover property assessment. - Validate promising alternative transport mechanisms (including chemical interactions) of contaminants through porous media at micropore scale.
Total	732	

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	120211	125314	125613	128578	131489	148438	157541	163700	Continuing	Continuing
AF20 Advanced Propulsion Research	2282	2068	2426	2504	2608	3006	3235	3378	Continuing	Continuing
AF22 Research in Vehicular Mobility	446	469	474	486	495	605	666	689	Continuing	Continuing
AH42 Materials and Mechanics	1817	1647	1919	1987	2045	2377	2520	2625	Continuing	Continuing
AH43 Research in Ballistics	5407	3150	4025	4131	4240	4480	4783	4962	Continuing	Continuing
AH44 Advanced Sensors Research	3834	4410	4062	4156	4250	4515	4796	4957	Continuing	Continuing
AH45 Air Mobility	1836	1880	1991	2044	2102	2528	2807	2913	Continuing	Continuing
AH47 Applied Physics Research	2910	2643	3080	3177	3275	3734	4099	4269	Continuing	Continuing
AH48 Battlespace Information & Communications Res	6709	5614	6762	6940	7126	7568	8039	8523	Continuing	Continuing
AH52 Equipment for the Soldier	857	866	944	981	1015	1222	1306	1364	Continuing	Continuing
BH57 Scientific Problems with Military Applications	48713	52727	50713	51786	52798	58179	59685	61620	Continuing	Continuing
AH66 Advanced Structures Research	1320	1207	1411	1459	1508	1607	1875	1958	Continuing	Continuing
BH67 Environmental Research - Army Material Cmd	3305	3235	3529	3586	3653	4069	4163	4363	Continuing	Continuing
AH68 Processes in Pollution Abatement Technology	316	370	370	377	382	451	459	478	Continuing	Continuing
BS04 Military Pollutants and Health Hazards	535	572	625	635	645	757	776	800	Continuing	Continuing
BS13 Science Base/Medical Research infectious Disease	8341	9090	8997	9206	9425	11890	12642	13373	Continuing	Continuing
BS14 Science Base/Combat Casualty Care Research	3704	3664	3972	4056	4143	4701	5360	5640	Continuing	Continuing

		DATE **February 1999**									
BUDGET ACTIVITY **1 - Basic Research**		PE NUMBER AND TITLE **0601102A Defense Research Sciences**									
BS15	Science Base/Army Operational Medicine Research	4990	9341	5378	5508	5640	7351	8286	8572	Continuing	Continuing
BS17	Molecular Biology/Military HIV Research	412	397	435	441	448	485	648	667	Continuing	Continuing
BS19	Telemedicine Soldier Status Research	0	465	615	624	635	614	677	709	Continuing	Continuing
AT22	Soil and Rock Mechanics	1798	1802	1869	1898	1929	2197	2546	2619	Continuing	Continuing
AT23	Basic Research/Military Construction	1427	1564	1579	1605	1630	1907	2209	2271	Continuing	Continuing
AT24	Snow, Ice and Frozen Soil	1357	1157	1166	1184	1204	1410	1627	1673	Continuing	Continuing
BT25	Environmental Research - Corps of Engineers	4209	4135	4458	4530	4601	5042	5134	5343	Continuing	Continuing
A305	Automatic Target Recognition Research	1110	1019	1174	1207	1239	1377	1528	1585	Continuing	Continuing
A31B	Infrared Optics Research	2202	1998	2341	2421	2504	2893	3121	3259	Continuing	Continuing
B52C	Mapping and Remote Sensing	2026	2284	2305	2342	2379	2785	3236	3328	Continuing	Continuing
B53A	Battlefield Environment and Signature	3470	3146	3678	3804	3942	4614	4928	5143	Continuing	Continuing
B74A	Human Engineering	2453	2248	2607	2685	2766	3175	3446	3586	Continuing	Continuing
B74F	Personnel Performance and Training	2425	2146	2708	2818	2862	2899	2944	3033	Continuing	Continuing

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences

A. Mission Description and Justification: This program element is focused on sustaining the Army's technological superiority for effectiveness in land warfighting capability and the Army Vision for Force XXI and the Army After Next (AAN). The program focuses in-house laboratory research on Army unique expertise and capabilities, capitalizing on the scientific talent and specialized facilities to expeditiously transition the resulting knowledge and technology into the appropriate developmental activities. The extramural program leverages the research efforts of other government agencies, academia, and industry for those areas where the Army does not have the technical lead. This translates to a coherent, well-integrated program which is executed by the following six primary contributors: 1) the Army Research Laboratory (ARL); 2) the seven Army Materiel Command Research, Development and Engineering Centers (RDECs); 3) the four Army Corps of Engineer laboratories; 4) the six Army Medical Research and Materiel Command laboratories; 5) the Army Research Institute; and 6) the Army Research Office (ARO). The Army's research program promotes quality through activities such as in-depth reviews of the entire basic research program at all levels and the development of strategic research objectives. The Army broadened its research base by expanding basic research investment in Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs) to 5% of its individual investigator program. This core research program is complemented by the inter-disciplinary research performed under the University Research Initiative (URI) program. The basic research program is coordinated with the other Services via the Joint Directors of Laboratories panels, Project Reliance, and other interservice working groups. The work in this program element is consistent with rigorous peer review, the Army Science and Technology Master Plan (ASTMP), Science and Technology Objectives (STOs) milestones for the Army's key emerging technologies, and the Army Modernization Plan. The projects in this PE involve basic research efforts directed toward providing fundamental knowledge for the solution of military problems. The resultant science base provides the source for follow-on applied research (6.2) and, eventually, advanced technology development (6.3) programs.

Work in this program element is related to and fully coordinated with efforts in PE 0601104A (University/Industry Research Centers), PE 0602120A (Electronic Survivability and Fusing Technology), PE 0602618A (Ballistics Technology), PE 0602623A (Joint Service Small Arms Program), PE 0602624A (Weapons and Munitions Technology), PE 0602720A (Environmental Quality Technology), PE 0602784A (Military Engineering Technology), PE 0602786A (Logistics Technology), PE 0602787A (Medical Technology), PE 0603105A (Medical Human Immunodeficiency Virus (HIV) Research), PE 0603002A (Medical Advanced Technology), PE 0603807A (Medical Systems-Advanced Development), PE 0604807A (Medical Materiel/Medical Defense Equipment-Engineering Development), PE 0605801A (Program wide Activities, Project MMO2), PE 0605898A (Management Headquarters R & D, Project MMO3), and PE 0601103D (University Research Initiatives); the Navy, Air Force, and other Department of Defense agencies; National Aeronautics and Space Administration; National Science Foundation; Department of the Interior; Department of Energy; National Bureau of Standards; other government agencies; and government agencies of Allied nations sponsor related research in areas of this program.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	121827	137399	144863	148336
Appropriated Value	125798	126463		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-3971	-1149		
b. SBIR / STTR	-2338	-3079		
c. Omnibus or Other Above Threshold Reductions	-773			
d. DoD Internal Reprogramming	+1500			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-19096	-20293
Current Budget Submit (FY 2000 / 2001 PB)	120216	122235	125767	128043

Change Summary Explanation: Funding – FY 1998 DoD Internal Reprogramming (+1500) realigned funds from Defense health Programs for proper program execution.

FY 1999 Congressional reduction to President's Budget request (-10936).
FY 2000 reduction (-19096) due to rebaselining of Army Basic Research Program and return of HBCU/MI Program to OSD.
FY 2001 reduction (-20293) due to rebaselining of Army Basic Research Program and return of HBCU/MI Program to OSD.

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AF20

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AF20 Advanced Propulsion Research	2282	2068	2426	2504	2608	3006	3235	3378	Continuing	Continuing

Mission Description and Justification: This project is a joint Army/NASA effort and it is the only DoD basic research project focused on turboshaft engine-specific technology and mechanical power transmission technology. 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. Analysis, code development, experiments and evaluations are conducted to improve engine and drive train components and investigate advanced materials. Component level investigations include compressors, combustors, turbines, injectors, pistons, cylinder liners, piston rings, gears, seals, bearings, shafts, and controls. The goal of the activity is increased performance of small airbreathing engines and power trains that will support improvements in system mobility, reliability and survivability, and ultimately serve to reduce the logistics cost burden. Logistic issues are key concerns in the Army After Next planning.

FY 1998 Accomplishments:

- 2282 - Completed 3-D particle image velocimetry mapping of compressor/diffuser flow field to provide fundamental information essential for advanced high performance centrifugal compressor design.
  - Completed Version 1.0 (unstructured grid version) of the National Combustor Code and release to US industry for the design of next generation gas turbine combustors.
  - Obtained fundamental heat transfer data for developing/validating wall function models for 3-D Navier Stokes internal/external cooling flow and heat transfer calculations. The new insights into the coupling of internal cooling and film cooling heat transfer will enable high performance turbine designs with less reliance on parasitic cooling flow.
  - Completed installation of a high-speed helical gearing loss-of-lube rig. This rig will enable improvements to rotorcraft transmission safety while reducing lubrication system weight.
  - Completed characterization of oxidation resistant coatings for monolithic silicon carbide and large fiber diameter reinforced composite. These coatings are mandatory for successful implementation of ceramic matrix composites (CMCs) in high temperature gas turbines.
  - Developed preliminary life prediction methodology for advanced CMC material that addresses the major thermomechanical issues concerning their introduction into manned gas turbine engines.
  - Developed and validated a diesel piston thermal barrier coating (TBC) low cycle fatigue/ high cycle fatigue facility and methodology to duplicate engine failure conditions and evaluate new coatings. The facility will screen candidate TBCs for use on test specimens (pistons) that will be tested by the Army Tank and Automotive Command.
  - Developed comprehensive analytical model of planetary gearset dynamics. Model has yet to be validated against experimental results. Will enable reduction of planetary gear vibration and noise.

Total 2282

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: AF20

FY 1999 Planned Program:

•	2054	- Demonstrate quick execution (overnight turn around) for Version 2.0 of the National Combustor Code, providing an increased incentive for industry to use the code. - Complete 3-D gear crack propagation code to improve transmission safety. - Demonstrate improved high temperature mechanical property stability of SiC/SiC composite through microstructural control. - Complete experimental investigation of stator end wall blockage and fillet geometry effects performance of multistage axial compressor. These results will ultimately enable significant improvements in compressor efficiency to be realized through reductions in secondary flow losses. - Calibrate 3-D gear crack propagation code with data from Boeing single tooth bending fatigue test gear in order to improve transmission design safety. - Develop material and lead wire attachment technique for ceramic based thin film strain gauges for use to 1200^{o}C.
•	14	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	2068	

FY 2000 Planned Program:

•	2426	- Apply particle image velocimetry to centrifugal compressor research stage at peak operating point to capture detailed flow physics associated with the onset of stall/surge. This data will enable the realization of flow physics based active stabilization and hence improved component efficiency. - Characterize the coupling between internal convection and external film cooling for turbine blades. The resulting models will provide insight into the internal cooling and film cooling heat transfer process, and ultimately improve efficiency by reducing the need for parasitic cooling flow. - Complete development of micro-electromechanical systems (MEMS) based heat flux sensor, thereby enabling high spatial resolution heat flux measurements to be made on turbomachinery airfoils. The end results are improved design and analysis codes for turbomachinery heat transfer. - Complete development of comprehensive thermomechanical life prediction model for advanced structural ceramics enabling insertion of durable structural ceramics into manned gas turbines. - Acquire data for validation of 3-D finite element analysis for spiral bevel gear thermal behavior, leading to reduced rotorcraft drivetrain weight and increased safety. - Complete cooperative project with industry to determine best gear tooth crack detection algorithms for improved rotorcraft transmission safety. - Complete development and validation of rotorcraft planetary gear dynamics code as a tool to minimize noise and vibration - Complete development of MEMS based strain gage enabling high spatial resolution measurements to be made on turbomachinery airfoils. The end results are validated performance characteristics for high temperature turbomachinery components.
Total	2426	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences
	PROJECT: AF20

FY 2001 Planned Program:

•	2504	- Incorporate environmental effects in life prediction model for advanced structural ceramics, including effects due to combustion products. - Develop waverotor concept for on rotor combustion, thereby integrating high-pressure turbomachinery and combustor component functions into a single component. This cycle is projected to reduce fuel consumption by 16% and increase specific power by 18%. - Apply and assess the validity of newly developed engine weight and safety prediction algorithms. These algorithms will forecast the impact of new advanced technology on the weight and safety of new engines. - Complete development and proof-of-concept test of smart sensor system for engine component damage prediction and control. - Complete development and validation of highly reliable, integrated gear fault detection methodology for improved rotorcraft transmission safety and reliability.
Total	2504	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AF22

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AF22 Research in Vehicular Mobility	446	469	474	486	495	605	666	689	Continuing	Continuing

Mission Description and Justification: This project conducts research in support of advanced military engine technology with emphasis on advanced propulsion, sophisticated vehicle dynamics and simulation, and advanced track and suspension concepts. Advanced propulsion research will dramatically improve power density, performance and thermal efficiency for advanced adiabatic diesel engines, transient heat transfer, high temperature materials and thermodynamics. This project also supports state-of-the-art simulation technologies to achieve a more fundamental understanding of advanced high-output military engines. The subject research is directed at unique, state-of-the-art phenomena in specific areas such as: 1) non-linear ground vehicle control algorithms, using off-road terrain characteristics; and 2) instantaneous diesel engine low friction/cold start optimizations, using advanced analytical and experimental procedures. The subject efforts offer an opportunity to produce quantum Army ground vehicle performance enhancements through the use of optimized parameterization procedures.

FY 1998 Accomplishments:

- 446 - Formulated state-of-the-art non-linear vehicle dynamics insights.
  - Established vehicle/human control algorithms for military systems performance enhancements.
  - Validated fundamental power train component models for unique ground vehicles.

Total 446

FY 1999 Planned Program:

- 460 - Validate state-of-the-art vehicle dynamics phenomena.
  - Optimize vehicle/human control models for off-road scenarios.
  - Optimize fundamental power train characteristic phenomena using advanced simulation procedures.
- 9 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 469

FY 2000 Planned Program:

- 250 - Validate advanced power train simulation algorithms.
  - Derive militarily relevant system powertrain sensitivities.
- 224 - Enhance state-of-the-art, real-time vehicle dynamics understanding.

Total 474

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
	PROJECT AF22

FY 2001 Planned Program:

•	240	- Fundamentally improve unique propulsion combustion/fuel injection modeling capability.
•	246	- Use high fidelity non-linear validation techniques to examine military vehicle response.
Total	486	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AH42

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH42 Materials and Mechanics	1817	1647	1919	1987	2045	2377	2520	2625	Continuing	Continuing

Mission Description and Justification: This project funds the Army's basic research program in materials science. The goal is to establish the science base allowing the creation and production of advanced materials which will provide higher performance, lower cost, improved reliability, and environmental compatibility for Army unique applications. Emphasis is on understanding the fundamental aspects of chemistry and microstructure that influence the performance and failure mechanisms of materials. This research is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD and Langley, VA.

FY 1998 Accomplishments:

- 1817 - Designed polymer systems that possess the ability to form novel nanomolecular architectures for possible use as protective clothing, membranes and coatings.
  - Developed guiding principles and novel processing technology for repair and fabrication of composite materials using magnetic induction.
  - Validated cure simulation models for resin transfer molding of polymer matrix composites.
  - Established processing guidelines for the microstructural design of ceramic materials tailored to improve lightweight armor performance.
  - Developed flow and fracture theory for large, high rate deformation of solids under coupled electromagnetic and mechanical forces to improve armor and armament design capabilities.
  - Collaboration begun with Brunel Univ. (UK) in "adaptive methods for viscoelasticity modeling", supported by the U.S. Army Research, Development and Standardization Office, UK, and with Virginia Polytechnic Institute on "damped structures", supported by the Army Research Office.
  - Cooperative Research and Development Agreement (CRDA) activity begun with Penn State Univ. and Lord Corp., Erie, PA on computational modeling of elastomeric materials used in helicopter bearings and dampers.

Total 1817

FY 1999 Planned Program:

- 1636 - Conduct fundamental experimental and modeling studies to help understand and predict the effects of constituents, fiber architecture and fiber-matrix microstructure on the low-cycle fatigue characteristics of polymer matrix composite materials.
  - Couple micro and macro models for micromechanical damage/failure prediction in thick section composites for future lightweight vehicles and ordnance.
  - Investigate the formation and effects of AlON ceramic microstructure on physical properties critical for transparent armor applications.
  - Develop models and basic guidelines for engineering surface sensitive properties of materials using energetic directed ion-laser beam techniques

- Conduct fundamental experimental studies to determine the dynamic behavior and defeat mechanisms of conceptual armor materials subjected to multiple external excitations.

FY 1999 Planned Program: (continued)

- Leverage the cooperative work with Brunel Univ. to improve adaptive integration methods for modeling elastomeric materials and highly damped structures, and transfer in-house nonlinear viscoelastic models of elastomers to Penn. State Univ. and Lord Corp., Erie, PA.
- Develop failure criteria for thick curved composites.

•	11	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	1647	

FY 2000 Planned Program:

•	1919	- Determine the synthesis-microstructure-property relationships in polymer/clay nanocomposite materials. - Refine low cycle fatigue predictive models for integrally-designed armor composite materials that include effects of material flaws and damage. - Investigate processing-microstructure effects on elastic properties of a functionally graded material. - Extend predictive models and experimental techniques for cluster beam and pulsed laser ablation deposition of protective coatings. - Investigate and develop coupled theoretical models for constitutive laws governing the high strain rate behavior of lightweight metal alloys and hybrid armor candidate materials. - Investigate transfer of elastomer modeling technology to commercial design code venders and to the aviation community, and investigate multidimensional time-space adaptive 'demeshing' techniques. - Validate bond strength through nondestructive evaluation (NDE) on selected composite structures.
Total	1919	

FY 2001 Planned Program:

•	1987	- Investigate the effects of interfacial chemistry on the engineering properties and microstructural damage/failure mechanisms of organic/inorganic nanocomposites. - Explore novel technologies for damage detection and mitigation in lightweight, multifunctional armor materials. - Investigate alternative uses of cluster beam techniques to enhance surface quality and durability in vacuum processes. - Investigate shock response and micromechanical damage/failure mechanism of a functionally graded material. - Investigate failure mechanisms in metal/ceramic hybrid materials under complex stress states and conduct two-dimensional shock experiments on novel, lightweight armor materials. - Evaluate the possible extension and application of this computational, elastomeric material modeling technology area to intelligent material systems, including electro-rheological fluids. - Initiate Phase II bond strength program to develop and validate advanced methods and hardware
Total	1987	

	DATE **February 1999**
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601102A Defense Research Sciences**

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences	PROJECT: AH43

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH43 Research in Ballistics	5407	3150	4025	4131	4240	4480	4783	4962	Continuing	Continuing

Mission Description and Justification: This project funds the Army's basic research program in ballistics. The goal is to improve the understanding of the chemistry and physics principles 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 development of more energetic propellants, more accurate and lethal projectiles and missiles, and advanced armors for increased survivability of Army combat systems. This research is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD in support of ballistic technology applied research in project 0602618A/AH80.

FY 1998 Accomplishments:

- 5407 - Modeled the physics of advanced solid propellant charge combustion to develop tools that will enable the design of new propulsion concepts, improve charge reliability, ease optimization, and simplify charge malfunction diagnosis.
- - Applied computational fluid dynamic and calculation technologies to both high and low speed Army systems, e.g., munitions, missiles, and parachutes, to develop tools to reduce design costs.
- - Measured and modeled the response of advanced armor materials to ballistic loads to provide fundamental methods for building more effective lightweight armor systems.

Total 5407

FY 1999 Planned Program:

- 3149 - Develop computational and experimental capabilities to predict the ignition, combustion, burn rate, and mechanical properties of propellants from new ingredients to revolutionize the development of future high-performance solid propellants for ballistics applications.
  - Couple computational fluid dynamics and rigid body computational techniques to allow prediction of trajectories for advanced guided projectiles, rockets, and missiles.
  - Measure and model the couple effect of mechanical, electrical and magnetic fields on armor and projectile materials for ballistic applications.
- 1 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3150

FY 2000 Planned Program:

- 4025 - Develop theoretical chemistry and physics-based models, including 3-dimensional (3-D) ballistics models of future high performance solid propellants, validated by ignition and combustion experimentation, to predict mechanical stability, impetus, energy release, flame temperature, and critical intra- and inter-molecular propellant properties.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
PROJECT AH43	

FY 2000 Planned Program: (continued)

- Couple computational fluid dynamics/thermal/rigid body dynamics tools for complex aerodynamic shapes and launch dynamics of advanced munitions.
- Incorporate coupled constitutive models into the magneto-solid-mechanics version of the CTH model being developed as part of the workpackage on electro-dynamic defeat of anti-armor threats.
- Perform shock wave propagation experiments in functionally graded materials to determine the effect of directionality on its shock, release, tensile and energy dissipation properties. Determine the effect of the material property gradient on wave front curvature and amplitude for general directions of propagation.

Total 4025

FY 2001 Planned Program:

- 4131 - Refine predictive first principles of chemistry and physics-based models and 3-D interior ballistics models and apply ignition and combustion experimental data to predict ballistic properties of advanced high-performance solid propellants in propulsion systems.
- Develop advanced computational models, smart munitions aerodynamic prediction capabilities, and flight vehicle control element design tools to reduce design cycle time and cost of advanced munitions.
- Incorporate fundamental theory of shock propagation in Functionally Graded Materials (FGMs) into wave mechanics code and complete critical experiments to validate the model. Complete integration of FGM constitutive model to provide 3-D modeling capability for the design of FGMs that will enable lightweight AAN vehicle concepts.

Total 4131

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AH44

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH44 Advanced Sensors Research	3834	4410	4062	4156	4250	4515	4796	4957	Continuing	Continuing

Mission Description and Justification: This project exploits new opportunities in the basic sciences underpinning the technology areas of digital and image processing modules and algorithms, optical control of radar sensors, nonlinear optical materials and devices, remote sensing, emissive materials 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 developed to enhance performance of imagers and optical processors. For laser protection, nonlinear optical effects are being explored which will allow broad band protection. These nonlinear effects can also be used for optical image processing or holographic displays and storage.

FY 1998 Accomplishments:

- 1048 - Demonstrated multicolor multiplexing in holographic display system.
  - Determined effects of coherent versus incoherent illumination in optical/digital imager.
  - Initiated growth and processing of luminescent materials.
  - Developed technique for designing binary, subwavelength diffractive elements.
  - Showed proof-of-principle electro-enzymatic system for detection of organophosphate class of agents.
- 1334 - Developed electromagnetic models for metal and dielectric mines buried in different soil conditions.
  - Demonstrated super resolution enhancement of real-beam radar angular resolution using Scan Multiple Signal Classification (S-MUSIC) techniques.
- 526 - Implemented and analyzed potential solutions designed in previous fiscal year, producing a partially "fuzzy" data / image compression prototype.
  - Created algorithms for structured data text and adapting object technology to standards-based electronic data interchange (edi) in a multimedia exchange model.
- 926 - Developed computational algorithms and intelligent agents for function and process coordinated overlay of intelligence and logistics synthetic environments on the synthetic sand table / automated display environment.
  - Developed infrastructure to support high level architecture in a synthetic, distributed interactive simulation environment.

Total 3834

FY 1999 Planned Program:

- 739 - Demonstrate feasibility of optical limiter for TARDEC application.
  - Investigate and manipulate the luminescence properties of nano-crystalline phosphors and organic materials.

- Fabricate and characterize binary, subwavelength diffractive lens.

FY 1999 Planned Program: (continued)

- Investigate various optical and electro-chemical transduction mechanisms for point environment sensing.
- Investigate optical interferrometric techniques for environmental sensing.

•	2153	- Develop a real-time technique for extracting depth information from an image stream, captured by a variable focus single camera. - Investigate the possibility of performing image processing using the mathematics of partial differential equations implemented as a real-time parallel Analog opto-electronic processor. - Establish a correlation between trajectory likelihood and the magnitude of its associated exponent and develop a technique to evaluate closure models and their trajectories using Lyapunov exponents.
•	1433	- Explore and evaluate new imaging techniques to utilize UWB radar in a forward imaging configuration. - Calculate the cross-range super-resolution with a scanning radar for targets at various ranges using MUSIC.
•	85	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	4410	

FY 2000 Planned Program:

•	1529	- Initiate materials integration for improved hardened smart sensor incorporating optical/digital imaging. - Determine optimal luminescence material for low power high brightness display. - Investigate designs for low cost, low power imaging system for Warrior Extended Battlespace Sensor System (WEBS). - Integrate binary, subwavelength lens with vertical cavity surface emitting laser. - Record and fix grantings in moving 3D holograms. - Develop remote detection via laser particle sizing.
•	816	- Report on analysis of dielectric mine measurements. - Investigate cross-range super-resolution of complex targets with S-MUSIC.
•	1717	- Utilize fuzzy logic to control level of terrain detail and to model volumetric objects while maintaining a constant frame rate. - Investigate and report on techniques for the real-time rectification of sensor imagery utilizing features within the scene. - Utilize Lyapunov exponents based closure model to assess the improvement of turbulence calculations as related to acoustic and optical sensors.
Total	4062	

FY 2001 Planned Program:

•	2478	- Design and demonstrate low power high brightness display for Army applications. - Deliver nonlinear optical protection cell to TARDEC. - Characterize new class of point and remote environmental sensors. - Report on UWB ground penetrating radar utility analysis.

- Extend capabilities of S-MUSIC and blind deconvolution super-resolution algorithms and demonstrate applicability using field data.

FY 2001 Planned Program: (continued)

•	1678	- Demonstrate real-time rectification of sensor imagery utilizing features with the scene. - Investigate the effects of turbulence induced phase and intensity fluctuations on ground to ground laser systems and identify techniques to reduce the effects.
Total	4156	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: AH45

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH45 Air Mobility	1836	1880	1991	2044	2102	2528	2807	2913	Continuing	Continuing

A. Mission Description and Justification: Basic research in aerodynamics and avionics as applied to rotary wing aircraft. Analysis, code development, and test and evaluation are conducted on rotor unique aerodynamics, dynamics, performance, and aircraft performance and acoustics.

FY 1998 Accomplishments:

- 1836 - Completed scale model hover testing with a pneumatically actuated, trailing edge flap for high lift.
  - Developed and validated the HELIX-II gear design tool, which includes accelerated vorticity embedding method to prevent numerical dissipation problems.
  - Developed advanced aeroelastic concepts for damperless rotor systems to control ground/air resonance.
  - Developed a grid-adaptive, unstructured overset scheme for the OVERFLOW code to improve the resolution of the rotor wake system.
  - Integrated a panel methodology into an integrated aeromechanics analysis to model aerodynamics influence of fuselage and wing/empennage.

Total 1836

FY 1999 Planned Program:

- 1857 - Develop structure/actuator concepts for application to multi-controller active, on-blade systems for low vibration rotorcraft.
  - Design and fabricate a scale model equipped with oscillatory blowing to control flow separation.
  - Fabricate and test an isolated, instrumented baseline rotor for increased payload, reduced noise and vibration.
  - Develop stereo particle image velocimetry for rotor wake measurements.
  - Develop advanced aeroacoustic prediction code using parallel computer.
  - Develop pressure sensitive paint technique for blade surface pressure measurement.
  - Perform forward flight aeroelastic stability testing of swept tip hingeless rotor blades.
  - Investigate aeroelastic and dynamic response of on-blade elevon controls for vibration reduction.
  - Design, fabricate, and test a scale model equipped with oscillating blowing to control flow separation.
- 23 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1880

FY 2000 Planned Program:

- 1991 - Complete the development of stereo image velocimetry technique.
  - Complete detailed rotor wake geometry measurements during blade/vortex interaction using stereo image velocimetry technique.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences
	PROJECT: AH45

FY 2000 Planned Program: (continued)

- Complete an axial-flight wind tunnel test to separate induced power from total power measurement.
- Design and fabricate scale model rotor blades equipped with oscillating blowing to control flow separation.
- Perform analytic validation of swept tip blade stability characteristics.
- Conduct parametric studies of active control with on-blade elevons for low vibration rotors.

Total 1991

FY 2001 Planned Program:

- 2044
  - Complete rotor aerodynamic and acoustic codes using scalable software.
  - Complete hover test using model blades equipped with oscillating blowing to control flow separation.
  - Investigate aeroelastic coupling characteristics for improved rotor stability.
  - Validate analytical methods for on-blade control vibration characteristics.

Total 2044

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AH47

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH47 Applied Physics Research	2910	2643	3080	3177	3275	3734	4099	4269	Continuing	Continuing

Mission Description and Justification: The objective of this project is to investigate the physics of various phenomena occurring in semiconductor structures, including thin heterostructure systems where quantum confinement effects are important. The basic knowledge learned will be applied to develop novel optoelectronic devices and test their performance. Active and passive optoelectronic components and subsystems will be developed that are of importance for Army systems. These include applications for Army optical control of microwaves, tactical wireless communications, and optical signal processing. From a logistical point of view it is important that the Army capitalize on advancements in semiconductor optoelectronics because of the potential for vastly reduced system size, weight, and cost as well as for the drastic improvements in system performance that optoelectronics can provide.

FY 1998 Accomplishments:

- 2565 - Developed improved model for Q-switched materials for eye-safe laser rangefinders.
  - Determined inaccuracies in current Global Positioning System (GPS) system and problem with GPS MAGR.
  - Demonstrated enhanced performance of oxidized Vertical Cavity Surface Emitting Lasers (VCSELs).
- 345 - Synthesized new salts for organic electrolyte based high energy capacitor for burst communications/vehicular applications.
  - Discovered better additive to enable use of low temperature electrolytes for rechargeable lithium-ion battery for individual soldier applications.

Total 2910

FY 1999 Planned Program:

- 2143 - Initiate growth and processing of GaSb based materials for Type II quantum cascade lasers and infrared (IR) detectors.
  - Develop realistically correct algorithm for GPS positioning and time transfer within the framework of general relativity.
  - Develop strain-effect-enhanced wave-guide modulators and amplifiers.
- 483 - Synthesize new anode material for higher energy rechargeable batteries for reduced weight and cost.
  - Develop new electrolyte solvents for capacitors and rechargeable lithium-ion batteries.
  - Synthesize/evaluate new cathodic electrocatalysts for high performance methanol fuel cells for individual soldier applications.
- 17 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2643

FY 2000 Planned Program:

- 2480 - Demonstrate feasibility of Q-switched eye-safe laser.
  - Develop InAs/GaSb based superlattice detector and laser structures.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: AH47

FY 2000 Planned Program: (continued)

- Implement new micro-cavity structures in advanced VCSELs.
- Explore semiconductor strain effects and wideband gap physics for future opto-electronic components.

• 600 - Investigate/eliminate side-reactions limiting storage and low temperature performance of new, more energetic anode material for rechargeable lithium-ion batteries.
- Synthesize new solvent for capacitor electrolyte to enable low temperature operation in burst communications applications.
- Evaluate conductivity and chemical stability of new membrane electrolytes for high performance fuel cell.

Total 3080

FY 2001 Planned Program:

• 2536 - Demonstrate electrically pumped interband quantum cascade laser with optimized operating characteristics and develop InAs/GaSb based superlattice detector.
- Initiate development of wideband gap active device structures.

• 641 - Formulate solid electrolyte for rechargeable lithium battery with high energy density/good low temperature performance.
- Formulate new high voltage low temperature electrolyte for high performance electrochemical capacitor.
- Develop improved Li/polymer battery chemistry for long storage, high energy density battery.
- Develop improved chemistry for direct methanol fuel cell.

Total 3177

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AH48

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH48 Battlespace Information & Communications Res	6709	5614	6762	6940	7126	7568	8039	8523	Continuing	Continuing

Mission Description and Justification: This project addresses fundamental research in technologies that will enable the development of intelligent and survivable command, control, communication, and intelligence systems. As the combat force structure becomes smaller and operates in more dispersed formations, information systems must be developed that are more robust, intelligent, interoperable, and survivable if the Army After Next is to retain both information and maneuver dominance. This research will address the areas of information warfare survivability and the related signal processing for wireless battlefield communications along with intelligent systems for C4I. The information warfare and signal processing research will develop capabilities that will enable the Army to overcome the inherent vulnerabilities associated with using standardized protocols and commercial technologies while addressing survivability in a unique hostile military environment that includes highly mobile nodes and infrastructure, bandwidth-constrained communications at lower echelons, diverse networks with dynamic topologies, high level multi-path interference and fading, jamming and multi-access interference, and information warfare threats. The intelligent systems for C4I research will focus on developing 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 reduce the size of tactical operation center (TOC) staffs. The project also supports the Army High Performance Computing Research Center (AHPCRC) at the University of Minnesota in FY98; the Center is supported in PE 0601104A, Project BH53 beginning in FY99.

FY 1998 Accomplishments:

- 5122 - Evaluated through simulation secure mobility management techniques for mobile host protocols that support dynamic tactical network reconfiguration.
  - Through simulation software, evaluated intelligent agents for information system vulnerability assessment and other C41 applications.
  - Evaluated multiple intelligent agent architecture that will support cooperative and collaborative agents to enhance the performance of AAN command supports systems.
  - Investigated and prepared a paper on the issue related to the interaction of humans and intelligent agents.
  - Outlined requirements and approach for the development of an Alert Agent that will focus user attention to key events.
  - Initiated research to develop a theoretical foundation for cooperative intelligent agents to achieve the AAN goal of mental agility.
- 1587 - Developed advanced 3-D computational techniques capable of modeling coupled fluid-structure around flexible membranes. This technology is important for modeling the deployment and flight of large ram air parachutes. The Air Force and NASA have expressed interest in the results of this work and are now collaborating with the AHPCRC and Natick RDEC on the development of this technology.
  - The work on two-phase fluid mixing of sloshing fluids and their effect on vehicle stability was expanded to include collaboration with researchers at TARDEC.
  - Developed an efficient fully parallelized version of the F3D code capable of solving steady state flow problems on 50 million point grids in a practical time.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: AH48

FY 1998 Accomplishments: (continued)

- A production version of parallel METIS was released. A workshop on mesh generation techniques was held with over 60 participants from the Army and DoD in attendance. Attendees were briefed on the capabilities of METIS and paraMETIS. These libraries are now being used by researchers at DoD Laboratories.
- Software was developed to study pore-scale velocity distributions in regular and random sphere packings using high-resolution, 3D simulation. This work was conducted in conjunction with CEWES.

Total 6709

FY 1999 Planned Program:

- 3540 - Validate the performances of secure mobility management techniques for mobile host protocols that support mobile ad-hoc network configurations.
  - Investigate survivable information architectures for information protection that addresses security, software reliability, data integrity, and system recoverability.
  - Define mobile distributed multiple access Anti-Jam (AJ) communication networks for brigade and below.
  - Validate and evaluate through simulation software intelligent agents that can detect information operations on combat networks.
  - Develop hierarchical digital modulation algorithms for classification and identification of signals on battlefield.
  - Develop robust spatial diversity combining algorithms for tactical communications
  - Develop algorithms for performing channel and source coding for tactical communications, with error correcting codes, that are capable of operating in high-bit error battlefield environments.
- 1987 - Utilize University of Maryland developed intelligent agent architecture to develop user alert agent technology.
  - Continue investigation of the interaction of humans and intelligent agents with a focus of agent autonomy.
  - Outline requirements and approach for an agent that monitors event detection and synchronization over bandwidth limited channels.
  - Continue investigation of theoretical foundation for cooperative intelligent agents that will underpin the Army After Next (AAN) Command Support System.
  - Investigate the application of soft computing techniques (fuzzy logic, neural nets, etc.) to enable agents to deal with uncertainly.
- 87 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 5614

FY 2000 Planned Program:

- 4219 - Refine secure mobility management techniques for mobile host protocol that support mobile ad-hoc networking on the move.
  - Refine intelligent agents for vulnerability assessment of dynamic tactical networks.
  - Evaluate concept for mobile distributed multiple access Anti-Jam (AJ) communication networks for brigade and below.
  - Complete investigation of survivable information architectures for information protection that address security, software reliability, data integrity and system recoverability.

- Evaluate and refine hierarchical digital modulation algorithms for classification and identification of signals on battlefield.

FY 2000 Planned Program: (continued)

- Continue development of spatial diversity combining algorithms for tactical communications.
- Evaluate and refine algorithms for performing channel and source coding for tactical communications that are capable of operating in high-bit error battlefield environments.

• 2543
- Begin validation of intelligent agent architecture by testing architecture and alert agent technology in collaboration with Advanced Battlefield Processing Technology Science and Technology Objective (STO).
- Publish a paper on the critical aspects of human agent interaction that must be considered in the development of agent applications.
- Assess the extensibility and adaptability of the intelligent agent architecture to the synchronization of physical and software agents against a user defined mission plan.
- Continue investigation to expand theoretical foundation for cooperative intelligent agents by focusing research on the language that will facilitate agent to agent communication.
- Evaluate the use of soft computing approaches to enhance the ability of agents to deal with uncertainty.
- Assess the application of intelligent agent technology to natural language understanding and context tracking.

Total 6762

FY 2001 Planned Program:

• 4080
- Demonstrate efficient algorithms for Internet protocols for highly mobile tactical networks.
- Demonstrate utility of hierarchical digital modulation algorithms by testing, identifying and classifying complex signals.
- Utilize a mobile ad-hoc network to interconnect a team of physical agents and higher echelons to demonstrate improved information flow.
- Demonstrate source and channel coding for tactical communications in high bit error battlefield environments..
- Validate hierarchical digital modulation algorithms for classification and identification of signals on battlefield.
- Validate performance of spatial diversity combining algorithms for tactical communications.

• 2860
- Transition to 6.2 a set of intelligent agents for mission planning, rehearsal and status monitoring of a physical agent.
- In collaboration with Advanced Information Processing STO, demonstrate the state of physical or software agents through a 2D/3D battlespace situation display.
- Evaluate the robustness of the theoretical foundation for cooperating agents by using its architecture and control language to integrate agents assessing the network vulnerability in conjunction with agents that monitor the execution of the mission.
- Validate the performance of natural language and context tracking agents that understand speaker's intent.

Total 6940

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AH52

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH52 Equipment for the Soldier	857	866	944	981	1015	1222	1306	1364	Continuing	Continuing

Mission Description and Justification: Basic research focused on five core technology areas critical to the Soldier System: mathematical modeling, physical performance measurement, polymer science/textile technology, biotechnology and food technology. Research is targeted toward 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 shortfalls in the availability of nutritious, performance sustaining rations essential to the health and well-being of soldiers.

FY 1998 Accomplishments:

- 857 - Mathematically modeled the energy dissipating effects of textile systems to predict the behavior of newly designed textiles.
  - Characterized polymeric "interphases" for optimization of ballistic and chemical agent protective properties.
  - Incorporated energy converting proteins into electroactive polymer matrices for enhanced signal transduction in optical devices.
  - Leveraged the Multidisciplinary University Research Initiative (MURI) for "functionally tailored fibers and fabrics" with the new electrospinning technology and initiated efforts to advance the state of the art of that technology.
  - Formulated and processed meat proteins to optimize microwaving as a new sterilization technique for military rations.
  - Measured and enhanced individual soldier mobility and related physical performance through biomechanics, anthropometry and nutrition assessments.

Total 857

FY 1999 Planned Program:

- 866 - Screen new materials using "electrospinlacing" technology for the production of "seamless" multifunctional protective clothing.
  - Validate mathematical models of textile damage effects from abrasion, strain, and ballistic impacts.
  - Incorporate production variables into the assessment of physical and chemical factors affecting non-linear optical behavior of candidate laser eye protective material.
  - Apply sophisticated analytical methodologies to formulated meat proteins to determine the effects of microwave sterilization of military rations.
  - Quantify soldier physical performance emphasizing biomechanical and anthropometric parameters of the soldier's load.
  - Characterize the form and function of polymer/clay nanocomposites relevant to high performance, multifunctional fabrics and structures for the protection of the future soldier.
  - Conduct computational experiments to provide validated model algorithms that predict the performance of airdrop systems using DoD High Performance Computing resources.

Total 866

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: AH52

FY 2000 Planned Program:

•	944	- Evaluate the mechanical properties of candidate nanocomposites to better understand functionality for lightweight soldier applications. - Electrospin blended polymers for further evaluation as candidates for multifunctional textile applications. - Extend the stability and functionality work on meat protein dynamics to include biopolymers and synthetic polymers yielding a broader application to enhanced soldier performance and injury recovery. - Investigate the structural and fluid dynamics of airdrop systems leading to development of an airdrop virtual proving ground.
Total	944	

FY 2001 Planned Program:

•	981	- Downselect candidate nanocomposites by varying composition and processing, yielding materials suitable for scale-up in 6.2, addressing lightweight Army After Next soldier requirements. - Transition blended electrospun fibers to 6.2 for scale-up and woven fabric applications. - Numerically couple the structural and fluid dynamics of airdrop systems using High Performance Computing yielding new technology to reduce life cycle costs of airdrop systems.
Total	981	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BH57

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH57 Scientific Problems with Military Applications	48713	52727	50713	51786	52798	58179	59685	61620	Continuing	Continuing

A. Mission Description and Justification: This extramural research project seeks to capture and exploit new scientific opportunities and technology breakthroughs, primarily at universities, to improve the Army's future operational capabilities. The Army Research Office maintains a strong peer-reviewed scientific research program through which technological improvements to warfighting capability can be assessed and implemented. Included are research efforts of scientific study and experimentation directed toward increasing knowledge and understanding in fields related to long-term national security needs and covering the physical sciences (physics, chemistry, biology, and materials sciences), the engineering sciences (mechanics, aeronautics, electronics, and mathematical and computer sciences), and the environmental sciences (atmospheric and terrestrial). It covers approximately 575 research grants and contracts with leading academic researchers and over 850 graduate students yearly, and supports research at over 100 institutions in 41 states.

FY 1998 Accomplishments:

- 23872 - Advanced materials research in the electrospinning of nanofibers demonstrated increased protection for the soldier from chemical and biological agents as well as lighter and more comfortable clothing.
  - Advanced chemistry research in supercritical water oxidation produced in a reactor model for the destruction of chemical weapon agents and hazardous munitions wastes.
  - Advanced physics research has produced the first mid-infrared quantum cascade laser to operate at room temperature. This type of laser is an excellent candidate for infrared scene projection and for sensors to detect toxic gases.
  - Through advanced biosciences research, developed the world's tiniest bacterial flaggellar motor which is providing insights into the design of miniature mechanical devices as well as mechanisms for energy conversion.
- 24846 - Advanced electronics research demonstrated the first omni-directional quasi-optical modulated oscillator array for antennas for mobile communications.
  - Advanced research in mathematical and computer sciences developed a successful game theoretic approach for handling conflict resolution in multiagent intelligent systems with applications such an autonomous air traffic management.
  - Advanced signal processing techniques which take into account the statistical nature of clutter effects of buried mines reduced the false alarm rates in electromagnetic induction mine detection systems by a factor of four.
  - Improved numerical simulations of turbulence in atmospheric boundary layer using an ultrahigh frequency radar system, mitigating environmental effects and thereby improving precision strike capabilities and battlefield visualization.

Total 48718

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BH57

FY 1999 Planned Program:

•	22545	- Advance materials research in nanocrystalline-amorphous metal composites to expand the range of possible microstructures that may reduce the weight and increase the performance of components in rotorcraft and land combat vehicles. - Advance chemistry research in dendrimers and hyperbranched polymers to provide a new class of nanoscopic building blocks for Army materiel. - Advance physics research to exploit the properties of nanometer-sized clusters of atoms to construct materials with unique functionality. - Advance biological sciences research in gene expression to determine the neural mechanisms that facilitate alertness and attention in the soldier.
•	23577	- Advance electronics research in bandwidth and power efficient modulation and doding to increase bit-rate throughput for tactical wireless communications. - Advance research in stochastic geometry to solve military problems related to the study of aerodynamics for improved rotorcraft maneuverability and for evaluating the strength of composite materials in Army vehicles. - Advance software and knowledge-based sciences in critical issues of complex reasoning and machine learning for multimedia digital information environments. - Advance fluid dynamics research in unsteady separation and dynamic stall to reduce vibration in rotorcraft and improve maneuverability and speed.
•	4700	- Enhance science, mathematics and engineering education programs at HBCU/MIs to improve their capacity to conduct science and engineering research in areas critical to the Army through the acquisition of state-of-the-art research equipment and instrumentation.
•	1905	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	52727	

FY 2000 Planned Program:

•	24466	- Advance biometrics research by exploring synthetic processing routes to laminated ceramic-polymer composites for improved armor. - Advance chemistry research to create reactive "smart" polymers that can react to external stimuli for thermal and visible signature reduction of soldiers and equipment. - Advance physics research to apply quantum effects such as entanglement and nonlocality to the development of enhanced techniques for information storage, communication, and processing. - Advance biosciences research to understand the molecular genetics of hibernation providing insight for soldier sustainment, performance and survival in harsh environments.

•	26247	- Advance electronics research by developing algorithms for efficient multicast distribution and broadcasting, and for scalable routing in very large tactical mobile communications networks. - Advance research in computational mathematics to model physical and operational phenomena for Army applications such as fluid dynamics for ballistics and rotorcraft, and for armor penetration mechanics. - Advance engine combustion research in thermal management in ultra-low heat rejection environments to improve propulsion in Army vehicles. - Conduct research in quantum computational analysis to develop revolutionary devices which can solve several types of "unsolvable" problems.
Total	50713	

FY 2001 Planned Program:

•	24991	- Advance materials research to improve annealing and thermo-mechanical processing procedures to improve the manufacture of metal alloy ceramics with superior mechanical properties for a multitude of Army systems. - Advance chemistry research to study molecular aging as a materials failure mechanism. - Advance physics research to self-assembly 3D photonic band gaps for potential application to single photon communications. - Advance biological sciences research to metabolically engineer enzymes, macromolecules and receptors to biologically remediate toxic materials.
•	26795	- Advance communications research through the design of novel access protocols needed to support multimedia traffic streams for mobile communications networks. - Advance research in computational geometry for discrete mathematical problems related to robotics, autonomous navigation and battle management. - Advance mechanical sciences research by exploring the feasibility of smart active/passive structural damping control utilizing magnetorheological fluid based dampers for stability augmentation of bearingless helicopter rotor blades. - Advance research in ice physics directed toward the development of durable ice-phobic coatings to prevent ice build up on antennas, rotor blades and power lines.
Total	51786	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AH66

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH66 Advanced Structures Research	1320	1207	1411	1459	1508	1607	1875	1958	Continuing	Continuing

Mission Description and Justification : 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); design and analyses of composite structures with crashworthiness as a goal; and the control of aircraft interior noise levels. These areas have application to the development of design tools for improved helicopter structures and dynamic response. This structures-focused technology includes reductions in vehicle vibratory loads, improved vehicle stability, advanced fatigue methodologies for metallic structures, improved composites technology throughout the vehicle, and long-term development of an integrated stress-strength-inspection technology. These technologies will extend service life, reduce maintenance costs, and enhance the durability of existing and future Army vehicles. The improved tools and methods will enable the design and use of composite structures that can better address the cost, weight, performance, and dynamic interaction requirements of future platforms, and ultimately result in safer, more affordable vehicles. As agreed under Project Reliance, this is the only project for rotorcraft and ground structures basic research within the DoD. No related effort is being conducted within DoD.

FY 1998 Accomplishments:

- 1320 - Completed design and fabrication of integral active twist rotor system for vibration reduction, modifications to the ARES testbed, and CAMRAD-II analyses to guide wind tunnel experiments.
  - Completed analytical investigation of effects of rotor blade aeroelastic parameters on rotor loads, and design model baseline rotor blades.
  - Modified comprehensive tilt rotor analysis for predicting stability of free-flight system including antisymmetric wing modes and completed aeroelastic response studies of tilt rotor systems with active controls for stability augmentation.
  - Published results of experiments to study scaling effects in tensile coupons under large deformation, completed draft of paper on state-of-the-art in scaling of composite materials and structures, and retrofitted second full-scale Lear Fan aircraft with energy absorbing subfloor beams.
  - Validated damage resistance and residual strength models for low velocity impact of stitched composite panels.
  - Performed parametric studies to develop design criteria for rotorcraft flexbeam geometry anomalies.
  - Validated 3D Finite Element Analysis (FEA) composite flexbeam strength and fatigue life predictions for combined tension/torsion loading.
  - Investigated benefits of secondary adhesive bonds and 3D reinforcements to increase composite stringer strength.
  - Conducted parametric studies to determine influence of flexbeam layup and material form on strength and fatigue durability
  - Evaluated structural parameters to understand and control crack growth geometry in stiffened panels.

Total 1320

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: AH66

FY 1999 Planned Program:

•	1203	- Develop improved multiblade formulation for comprehensive analysis, and validate dynamic and aeroelastic predictions for gimbaled tiltrotor; and under CRDA with Penn State, extend aeroelastic-tailoring studies for soft-inplane tilt rotor systems. - Publish test standards to measure delamination onset and fracture toughness of composite laminates, and develop probabilistic method for analyzing low velocity impact resistant in composite panels. - Develop fatigue analysis for arbitrary flexbeam layup under combined tension/torsion loads, and 3D damage primitives for matrix crack induced delamination failures.
•	4	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	1207	

FY 2000 Planned Program:

•	1411	- Develop experimental design of the wind tunnel test of twist actuated active rotor system 'open loop' configuration. - Publish results of actively controlled stability augmentation on tiltrotor configuration, and correlate with predictions from several analytical methods. - Validate bond strength NDE on selected composite structures.
Total	1411	

FY 2001 Planned Program:

•	1459	- Evaluate forward flight characteristics in wind tunnel test of twist actuated active rotor system in 'open loop' configuration. - Incorporate active control and smart material analytical models into comprehensive analysis. - Validate analytically modeled advanced fuselage concepts for future composite aircraft. - Complete thin-skin sandwich residual tension/compression biaxial tests.
Total	1459	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BH67

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH67 Environmental Research - Army Material Cmd	3305	3235	3529	3586	3653	4069	4163	4363	Continuing	Continuing

Mission Description and Justification: This project focuses basic research on innovative technologies for both industrial pollution prevention (P2) that directly supports the Army industrial base and for non-stockpile chemical warfare (CW) site remediation. The objective of the pollution prevention work is to invest 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. The goal is to reduce the cost of remediating a site by at least 50% verses the use of conventional methods. Pollution prevention thrusts include: environmentally acceptable advanced non-radioactive, non-toxic and lightweight alternative structural materials to enhance weapon system performance; substitutes for ozone-depleting chemicals as solvents, refrigerants, and firefighting agents for military unique applications; energetic synthesis and process improvements to eliminate the use of hazardous materials and to minimize the generation of wastes from manufacturing operations; and surface protection alternatives to hazardous paints, cadmium, chromium, and chromate conversion metal and composite surfaces. CW thrusts include establishing the ecotoxicity of CW compounds, environmental fate and effect of CW compounds in soils and biodegradation of CW compounds. This project is linked to the Tri-Service Environmental Quality R&D Strategic Plan and addresses environmental technology requirements addressed in that plan.

FY 1998 Accomplishments:

- 1978 - Developed optimized microbial consortia to biodegrade CW agents/products.
  - Characterized the ability of various supercritical formulations to effectively solubilize various organic polymeric binders (e.g., Viton-A, Hytemp) during the processing of pyrotechnics
  - Developed corrosion-resistant coatings, and plasma based decoating technologies.
- 1327 - Completed fabrication and examination of specimens prepared for hollow, cylindrical coating targets.
  - Continued bioceramics Langmuir-Blodgett studies, reverse micelle, or other suitable systems to mimic natural processes.
  - Conducted aqueous processing studies with elastomeric proteins for coatings.

Total 3305

FY 1999 Planned Program:

- 704 - Investigate new nanoscale composites of montmorillonite clay in polyesters and nylon to increase production and crystal type.
  - Modify aqueous based coatings to optimize functional properties for specific applications such as attaching peptides to polymers to accelerate chemical/biological warfare agent degradation.
- 791 - Optimize techniques for supercritical fluid triple-base demil/recycling. Transition to applied research in FY 2000.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BH67

FY 1999 Planned Program (continued):

- Identify techniques for accelerating formation of self-assembled monolayer protective coatings.
- 680 - Complete fabrication and examination of specimens prepared with wire-wrapped, solid, cylindrical, coating targets.
- 990 - Complete characterization, evaluation, and model validation of a Cylindrical Magnatron Sputtering (CMS) device and transition to applied research in FY 2000. CMS device may be critical capability needed to apply materials instead of heavy metals to components. Elimination of use of heavy metals is an important environmental goal.
- 70 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3235

FY 2000 Planned Program:

- 3529 - Optimize environmentally benign CL-20 synthesis process for use in bench scale evaluation.
- Continue model development and test and evaluate large caliber target configurations.
- Investigate candidate biodegradable materials for incorporation in montmorillonite clay nanocomposites produced by melt extrusion (solvent-free) methods.
- Complete studies of self-assembled monolayer-topcoat adhesion, and use of plasma surface treatment for improved adhesion.
- Develop Soil Ecotoxicological Database for labile CW Agent Compounds and related compounds in soil, based on soil bioassay measurements.

Total 3529

FY 2001 Planned Program:

- 3586 - Produce CL-20 and military grade 2,4-DNT at bench scale using new environmentally benign processes.
- Apply selected targets to medium and large caliber gun tubes for application of coatings which will be test fired.
- Characterize microstructural and performance properties of ceramic materials produced by biomimetic processes.
- Optimize Soil Ecotoxicological Screening Bioassays, and predictive capabilities, for labile CW Agent Compounds in soils.
- Characterize the chemical resistance and physical/thermal properties of monolayer-topcoat systems compared to conventional (heavy-metal based) primer-topcoat systems.

Total 3586

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AH68

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH68 Processes in Pollution Abatement Technology	316	370	370	377	382	451	459	478	Continuing	Continuing

Mission Description and Justification: This project provides fundamental understanding of the physical, chemical and biological properties and mechanisms that control the degradation and treatment of hazardous wastes on military installations. This research is used to obtain basic technical information necessary for the design of treatment systems for both cleanup of existing hazardous waste sites and control of future hazardous waste generation. Wastes of concern include explosives, propellants, chemical agents and smokes. This project supports applied research efforts in Program Element 0602720A, Projects AF25 and DO48.

FY 1998 Accomplishments:

• 316	- Provided implementation guidance on microbial destruction of TNT in soils. (U.S. Army Waterways Experiment Station - WES) - Developed a program to determine eco-physiological basis for enzymatic degradation of explosives and constructed a database on enzymatic degradation rates. (WES) - Completed studies on explosives bioprocessing in flow through bioreactors (U.S. Army Construction Engineering Research Laboratories – CERL).
Total 316	

FY 1999 Planned Program:

• 360	- Determine factors regulating enzymatic degradation of explosives, characterize DNA for regulation and production, and develop conceptual model for regulation. (WES) - Complete minimal growth requirements for bacteria involved with destruction of energetic wastes (CERL).
• 10	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total 370	

FY 2000 Planned Program:

• 370	- Produce and isolate enzymes responsible for degradation, characterize enzymes, and develop basic processes for isolating and characterizing enzymes. (WES) - Characterize the bacterial nitroreductase used for degrading nitramine and nitroaromatic explosives (CERL).
Total 370	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences
	PROJECT: AH68

FY 2001 Planned Program:

•	377	- Determine physiological conditions necessary for optimum enzyme activity, establish effectiveness of cell-free enzyme systems, develop basic processes to obtain enzyme stability and effectiveness. (WES) - Determine the role of hydrogen cycling in explosive nitroreductase enzymes. (CERL)
Total	377	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BS04

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS04 Military Pollutants and Health Hazards	535	572	625	635	645	757	776	800	Continuing	Continuing

Mission Description and Justification: This project provides basic research in 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. These new testing techniques will help to prioritize hazardous waste and waste treatment technologies and screen new Army chemicals for potential toxic effects. The work is conducted at U.S. Army Center for Environmental Health Research (CEHR) and U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM).

FY 1998 Accomplishments:

- 535 - Initiated development, improvements, and intralaboratory validation of specific sentinel environmental toxicity hazard assessment methods (CEHR).
  - Identified additional sentinel biomonitoring systems for toxicity hazard assessment. (CEHR)
  - Completed cross-species extrapolation of results from immunotoxicity studies in mammalian and non-mammalian bioassay systems. (CEHR/ CHPPM)

Total 535

FY 1999 Planned Program:

- 557 - Continue to develop, improve, and perform intralaboratory validation of specific sentinel environmental toxicity hazard assessment methods. (CEHR)
  - Identify additional sentinel biomonitoring systems for toxicity hazard assessment. (CEHR)
  - Transfer intralaboratory validated sentinel methods to PE 0602720A, Project A835 for interlaboratory and field validation and inclusion in an integrated toxicity hazard assessment package. (CEHR)
- 15 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 572

FY 2000 Planned Program:

- 625 - Identify additional sentinel biomonitoring systems for immunotoxicity and reproductive hazard assessment (CEHR).
  - Continue to develop, improve, and perform intralaboratory validation of specific sentinel environmental toxicity hazard assessment methods for immunotoxicity and reproductive toxicity. (CEHR)
  - Transfer intralaboratory validated sentinel methods for immunotoxicity assessment to PE 0602720A, Project A835 for further interlaboratory and field validation and inclusion in an integrated toxicity hazard assessment package. (CEHR)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences
	PROJECT: BS04

Total 625

FY 2001 Planned Program:

- 635 - Identify sentinel biomonitoring systems for neurobehavioral toxicity hazard assessment. (CEHR)
  - Continue to develop, improve, and perform intralaboratory validation of specific sentinel environmental toxicity hazard assessment methods for immunotoxicity and reproductive toxicity. (CEHR)
  - Initiate further development, improvement, and intralaboratory validation of sentinel environmental toxicity hazard assessment methods for neurobehavioral. (CEHR)
  - Transfer intralaboratory validated sentinel methods for reproductive toxicity assessment to PE 0602720A, Project A835 for further interlaboratory and field validation and inclusion in an integrated toxicity hazard assessment package. (CEHR)

Total 635

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BS13

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS13 Science Base/Medical Research infectious Disease	8341	9090	8997	9206	9425	11890	12642	13373	Continuing	Continuing

Mission Description and Justification: This project funds basic research on medical countermeasures for naturally occurring diseases which are militarily significant due to their potential impact on military operations. Development of medical countermeasures will protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations.

FY 1998 Accomplishments:

- 1631 Cloned, expressed, purified and assayed functional activity of a candidate malaria vaccine (recombinant EBA-175 protein) which may be used in a "rational" approach to vaccine design. Demonstrated the roles of CD8+ T cells, CD4+ T cells, IL-12 and NK cells in protective immunity in mice, necessary studies to guide future vaccine development and testing. Increased capacity for growing *Plasmodium vivax* in culture and devised methods for inducing *P. vivax* gametocytes in vitro, which are necessary requirements for studying vaccines in human challenge studies.
- 1460 Completed sequencing of *Plasmodium falciparum* chromosome number 2 in collaboration with the Institute for Genomics Research. Established Internet web sites at all major genome centers to facilitate open access to genomic data by all investigators. Genetic sequence data will make possible more rapid and specific design of vaccines and drugs against specific structural and functional proteins of *P. falciparum*. Provided all *P. falciparum* genetic material for ongoing international Malaria Genome Project by devising procedures and methods for identification and purification of chromosomes and construction of DNA libraries.
- 448 Identified five classes of functional proteins as potential targets for inhibitor drugs using the target and structure-based antimalarial drug design program at Walter Reed Army Institute of Research (WRAIR). Identified a new functional protein that may serve as a potential target for inhibitor drugs for the treatment and prevention of *Leishmania*. Identified new metabolites of new candidate antimalarial drugs (artelinic acid, arteether and artemisinin), a process necessary for establishing human toxicity and safety. Conducted surveillance for emerging drug resistance patterns in malaria parasites worldwide.
- 541 Completed epitope mapping of two additional *Shigella sonnei* invasion plasmid antigens (Ipa) proteins, necessary for discovering common immune epitopes among different *Shigella* species. Discovered and characterized DNA and polymerase-chain reaction (PCR) primers for identification of enteric pathogens, necessary for monitoring subjects in human clinical trials of candidate *Shigella* vaccines.
- 433 Constructed primers for PCR identification of pathogenic enterotoxigenic *E. coli* (ETEC) from clinical stool samples. Conducted surveillance for ETEC in over 500 clinical samples, including samples from U.S. forces training in Thailand, that is necessary for continuing risk assessment and for support of studies of vaccine candidates.
- 330 Identified specific *Campylobacter* antigens (flagellin) and toxins (cytolethal distending toxin) and improved understanding of post-translational glycosylation relevant to designing immunogenic, protective candidate vaccines. Improved methods and systems for expression of vaccine antigens in C*ampylobacter* species and *E. coli*, necessary for optimizing antigen content in candidate vaccines.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BS13

FY 1998 Accomplishments: (continued)

- 246 Incorporated primers which amplify the "rfc" gene which encodes O-antigen polymerases of *Shigella* species into a multiplex PCR with the *Campylobacter jejuni* "ceuE" gene, necessary for development of a sensitive, specific forward deployable diagnostic device capable of detecting multiple infectious pathogens of military interest. Prepared both recombinant and native hantavirus nucleocapsid antigens for use in diagnostic assays for hantavirus infection.
- 719 Devised techniques for engineering specific mutations in dengue virus, necessary for producing candidate, live-attenuated dengue vaccines. Devised quantitative reverse transcriptase (RT)-PCR assay in order to characterize Th1 and Th2 (helper T cell 1 and 2) responses to vaccination, necessary for comparing and down-selecting dengue candidate vaccines. Constructed type-specific fusion proteins using recombinant dengue antigens for improvement of capability of field diagnosis of dengue. Demonstrated very low in incidence of transmission of live-dengue vaccine to mosquitoes, necessary for evaluation of public safety of candidate, live-attenuated dengue vaccines.
- 674 Prepared candidate naked DNA vaccine expressing the M segment of Seoul Hantavirus (Korean hemorrhagic fever virus) for comparison and down selection with other candidate vaccines. Studied dynamics of molecular change and viral replication of Seoul Hantavirus as a means to understand persistence of Hantavirus in rats, necessary to provide insight into transmission prevention. Devised an assay of Hantaan viral polymerase function, necessary for design and assessment of antiviral drugs against Hantaan virus. Identified four new classes of compounds with potential for development as effective agents for treatment of hemorrhagic fever viruses. Conducted surveillance for Chikungunya virus and Hantavirus outbreaks in Indonesia, necessary to define potential sites for tests of candidate vaccines. Conducted serosurveys for Murray Valley virus and Ross River virus among equine populations in Indonesia and documented significant prevalence among three different stable populations, necessary studies for determination of potential risk to deployed personnel in the Australasian region. Conducted serosurveys of Hantavirus infections among rodent and human populations in the Amazon river basin, necessary for risk assessment to deployed personnel.
- 174 Devised a test for hepatitis E for use in field studies and vaccine trials. Identified rats in Nepal as a potential reservoir of hepatitis E virus (HEV), necessary for understanding and potentially preventing transmission of HEV to human hosts. Genetically characterized African strains of HEV and demonstrated sufficient genetic similarity between African and Asian strains of HEV such that a vaccine against Asian strains will likely be effective at preventing infections with African strains. Conducted risk assessment for HEV in rural Thailand and discovered that 3% of acute hepatitis is attributable to HEV.
- 223 Identified and characterized multiple antigens of *Orientia tsutsugamushi* for potential use in diagnostic tests for drug-resistant scrub typhus. Identified multiple primers for cloning genes of *O. tsutsugamushi*, potentially useful as markers for studying the pathogenesis of scrub typhus.
- 131 Constructed primers for evaluation of PCR methods for diagnosis of Leishmania infection, necessary for epidemiological and clinical study support and for future field studies of candidate vaccines.
- 125 Demonstrated induction of bactericidal antibodies by two candidate vaccines against an epitope common to most Group B meningococcal strains, important to selecting final design of candidate vaccines for prevention of disease caused by Group B meningococcus.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BS13

FY 1998 Accomplishments: (continued)

- 357 Conducted surveillance studies of febrile illness, respiratory disease, encephalitis, diarrhea, hemorrhagic fever and other illnesses in Asia, South America and Africa to identify potential new infectious disease risks for deployed forces. Designed a pilot influenza surveillance project for the Pacific Rim. Among 400 cases of encephalitis in Ho Chi Minh City, Vietnam, identified Japanese encephalitis as the major etiology, especially among children. Identified epidemic typhus as a significant etiology (28 of 78 cases) of febrile illness in an outbreak in Peru. Identified Mayaro fever as a significant cause (5 of 35 cases) of febrile illness in an outbreak in Peru. Studied over 2,900 patients who presented for evaluation of febrile illnesses
in urban communities in the Amazon rain forest. No hemorrhagic or encephalitic syndromes were observed. Demonstrated epidemic potential of Norwalk virus among shipboard populations in the U.S. Navy (attack rate of 40% aboard an aircraft carrier). Demonstrated an attack rate of 3.2% for *O. tsutsugamushi* (scrub typhus) with pre- and post-deployment screening of deployed U.S. personnel in Vietnam. Showed no significant transmission
of dengue. Demonstrated clinical (6 cases) and subclinical infection with Ross River virus and Bermah Forest virus using pre- and post-deployment screening among U.S. personnel during "Tandem Thrust" deployment. Established forward laboratory capabilities in Indonesia for diagnosis of Australasian viruses of potential military relevance.
- 704 Designed and synthesized 18 new compounds as potential candidates for replacement of DEET, the current standard for insect repellency. Identified xanthurenic acid as the chemical factor that stimulates malaria gametocyte exflagellation prior to zygote formation, of potential use in strategies for prevention of malaria transmission. Identified PCR primers for potential use in diagnostic tests of rickettsial diseases, especially scrub typhus. Devised species differentiating DNA markers in mosquito vectors that may be useful in developing strategies for control of malaria vectors.
- 145 Explored mechanisms of synthesis of bacterial, viral and parasitic antigens, necessary for process and manufacturing development for pilot production of vaccine and other biologics for research and field use.

Total 8341

FY 1999 Planned Program:

- 1799 Assess functional antibody responses to the *P. falciparum* MSP-1 protein and design modified MSP-1 proteins that will induce protective antibodies. Characterize memory T cell immune responses to leading vaccine antigen candidates. Incorporate initial data obtained from malaria genome project into vaccine development efforts.
- 1249 Begin sequencing of *P. falciparum* Chromosome 14. Design bioinformatics capability for rapidly identifying the best gene targets from the sequence data for entry into malaria vaccine and targeted drug programs.
- 880 Identify at least five different target proteins for structure-based drug design of novel antimalaria drugs. Establish combinatorial chemistry(used to create large libraries of compounds) program for discovery of new functional inhibitor drugs. Exploit emerging advanced technologies, including chip-based DNA microarrays, to discover methods and technologies to improve detection of drug-resistant malaria.
- 548 Determine best approach for a *Shigella dysenteriae* vaccine. Identify monoclonal antibodies to *Shigella* virulence proteins that could be used in a dipstick immunodiagnostic assay for *Shigella* in dysenteric stools.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BS13

FY 1999 Planned Program: (continued)

- 277 Study uptake and processing of microspheres in animals to understand how to stimulate maximum immune response to microsphere-based ETEC vaccine. Explore expression vectors for four defined ETEC colonization factor genes to identify candidate ETEC strains for live, avirulent vaccines. Explore an improved animal model for ETEC diarrhea.
- 304 Devise a system to reduce the effect of virulence genes, necessary to creation of organisms for use in live-attenuated *Campylobacter* vaccines. Identify bacterial and human factors associated with post-infectious reactive arthritis and Guillain-Barre syndrome.
- 224 Select specimen-processing procedures that yield optimal isolation of nucleic acids from medical specimens of whole blood, urine, stool, and spinal fluid to support a hand-held system for far-forward diagnosis of infectious diseases. Devise rapid diagnostic tests for far-forward diagnosis of enteric pathogens directly from stool specimens.
- 808 Identify and characterize potential components of future live-attenuated, killed, recombinant and DNA dengue virus vaccine. Identify and characterize potential components of future dengue diagnostic assays. Construct dengue nucleic acid candidate vaccines.
- 300 Construct primate monoclonal antibodies for use in immunotherapy for Crimean Congo hemorrhagic fever (CCHF) and Lassa virus infections. Identify common threads in the pathogenesis of the causes of viral hemorrhagic fevers (VHF), Lassa, CCHF and Ebola.
- 142 Genetically characterize up to 20 isolates of HEV from around the world to establish antigenic requirements for candidate vaccines.
- 222 Confirm presence of drug resistance in *O. tsutsugamushi*, the cause of scrub typhus. Identify genes from antibiotic-resistant scrub typhus organisms to construct and define mechanisms of antibiotic resistance.
- 262 Identify the role and effects of cytokines in *Leishmania* infection and resistance to infection.
- 122 Conduct molecular studies of optimized and multivalent vaccines made from Group B *Neisseria meningitidis* containing outer membrane proteins designed to protect recruits against bacterial meningitis.
- 470 Identify emerging pathogens that could put deployed soldiers at risk for febrile illnesses, respiratory disease, encephalitis, diarrhea, hemorrhagic fever and other conditions.
- 713 Synthesize by computer modified versions of the most efficacious candidate insect repellent. Devise wicking assays for the detection of insect vectors carrying Leishmania and mosquitoes carrying dengue virus.
- 295 Explore novel and improved methods of vaccine production and adjuvant research at the Vaccine Pilot Production Facility.
- 322 Identify and characterize potential components of future assays for hantavirus. Assess antibody and cell-mediated immune responses to candidate hantavirus vaccines in mice. Devise delivery system for alphavirus replicon vaccine. Conduct surveillance for hantaviruses in South America and SE Asia.
- 153 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 9090

FY 2000 Planned Program:

- 1367 Identify and characterize further the mechanisms of protective immunity and targets of protective immune responses against *P. falciparum* and *P. vivax*. Discover additional *P. falciparum* and *P. vivax* vaccine immunogens. Devise assays that measure markers of protective immunity.

FY 2000 Planned Program: (continued)

- 1449 Devise strategies for rapidly exploiting the genomic sequence for vaccine and drug development. Prepare *P. vivax* genomic DNA for sequencing.
- 1350 Identify candidate antimalarial drugs using chemical synthesis or by isolation from natural products. Identify techniques for the cultivation and drug sensitivity testing of *P. vivax* malaria. Employ molecular modeling to design antimalarial drugs. Identify, clone and express target proteins for structure-based drug design and determine modes of action and resistance of antimalarial drugs. Create a deployable field test to assay drug sensitivity patterns in malaria based on enzymatic, colorimetric, probe or micro-array technologies. Conduct target-based and whole organism screening systems
for assaying activity or determining cytotoxicity candidate drugs. Conduct assays to discover synergistic drug combinations or resistance modulator drugs. Create computer systems to analyze, merge and compare physicochemical and biological data. Maintain a drug repository to include acquisition, storage and distribution. Prepare drug delivery systems of compounds under Good Laboratory Practice/Good Manufacturing Practice (GLP/GMP) compliance. Conduct a surveillance program for drug-sensitivity patterns of malaria from diverse geographic regions.
- 504 Evaluate immune responses generated by candidate *Shigella* vaccines with the goal of establishing parameters of protection. Modify candidate live vaccines to reduce reactogenicity and/or excretion while retaining efficacy, allow rapid identification of excreted organisms, and enhance efficacy. Devise reagents for rapid and economical diagnostic techniques for use in *Shigella* vaccine trials. Construct polyvalent vaccines using live *Shigella* carrier(s) or subcellular protein carrier(s). Annotate *Shigella* plasmid DNA sequences to identify virulence determinants.
- 399 Characterize protective immune responses in humans and animal models. Characterize the predominant ETEC strains and associated virulence factors that occur in likely areas of military operations. Select candidate immunogens for inclusion in vaccine candidates.
- 273 Identify and characterize the full range of bacterial systems, antigens and toxins important in disease pathogenesis and protective immunity to provide the basis for development of vaccine candidates. Identify bacterial factors involved in inflammatory cytokine induction for potential development as vaccine antigens. Obtain knowledge of protein glycosylation in campylobacter and its importance in pathogenesis and modulation of the immune response, necessary for design of vaccine antigens. Define the role of cytolethal-distending toxin in disease and immunity. Further study of non-sialylated mutants as possible vaccine candidates to potentially mitigate safety issues such as vaccine-associated Guillain-Barre syndrome. Construct live-attenuated carrier vaccine candidates expressing campylobacter antigens. Construct combined vaccines expressing *Campylobacter*, *Shigella* and ETEC antigens. Utilize available genomic sequencing to identify and investigate important areas of virulence gene homology with other enteric pathogens and explore their role in campylobacteriosis. Study target sequences that appear to be unique to *Campylobacter*. Investigate metabolic pathways identified in the sequencing that may be exploited for the development of auxotrophic live-attenuated strains.
- 219 Devise specimen-processing methods that allow the purification of target nucleic acids in less than 30 minutes. Construct PCR primers and probes for diagnosis of malaria, enteric diseases, dengue viruses and the hemorrhagic fever viruses.
- 924 Identify predictors of long-term immunity (and safety) to establish basis for down-selection among competing dengue vaccine designs.

- 309 Assess mechanisms of pathogenesis to include viral-specific events and nonspecific factors including cytokines and coagulation factors in animal models of VHF and encephalitis. Construct primate monoclonal antibodies for evaluation of protective efficacy in animal models including primates. Improve capability to rapidly identify these agents in the field and provide definitive confirmation in reference labs. Investigate disease outbreaks to validate assays and obtain fresh field samples for viral isolation and antibody analysis.

FY 2000 Planned Program: (continued)

- 97 Establish level of antibody that prevents HEV disease. Complete characterization of human T-cell responses to HEV infection, disease, and vaccine. Continue epidemiological studies of HEV and virus phylogenetic analysis in Asia and Africa. Sustain or refute presence of hepatitis E disease among humans in Latin America using virus detection as basis for diagnosis. Characterize animal reservoir (particularly rodents) and animal HEV isolates. Characterize determinants and pathophysiology of fulminant hepatitis E.
- 268 Establish the degree of immunologic heterogeneity among available *Orientia* isolates. Define a set of *Orientia* isolates that exhibit little or no cross-protection against heterologous challenge in mice. Clone and sequence appropriate strain-specific antigens from appropriate non-crossprotective isolates for use in the development of a polyvalent scrub typhus vaccine. Prepare one or more potential vaccines candidates (e.g., recombinant, DNA) and evaluate their protective efficacy in mice against homologous challenge.
- 307 Analyze the human antibody response to specific selected components of the OMP-dLOS vaccine formulations. Determine the effect of lipid composition, lipid concentration, pH, and lyophilization on the structure and immunogenicity of the proteoliposome OMP-dLOS vaccine formulation. Identify three additional vaccine strain candidates with different (most prevalent) subtype antigens and genetically modify the strains to knock out sialic acid production and if necessary enhance expression of Opc.
- 821 Conduct risk assessment and identification of vectors other than dengue vectors. Design information products that improve the military's ability to identify vectors and evaluate their local importance to disease transmission. Establish a standard insecticide resistance and susceptibility test at each DoD research laboratory. Evaluate the threat of tick and chigger-borne diseases to the U.S. military. Identify and test new repellent candidates that will outperform DEET in durability, effectiveness, and user acceptability. Begin basic research on new devices for evaluating biting rate and distribution of dengue vectors. Prepare handbook and accompanying software for identification of dengue vectors, evaluation of dengue in humans and vectors, and most appropriate control and surveillance techniques. Continue preliminary refinement of a field device for detecting *Plasmodium* in vectors.
- 329 Devise processes for manufacture of at least 10 new vaccine lots under current Good Manufacturing Practices (cGMP) compliance.
- 381 Assess antibody and cell-mediated immune responses to candidate hantavirus vaccines in mice. Characterize and evaluate correlates of immunity in nonhuman primate and human infection with hantavirus. Conduct surveillance for hantaviruses in South America and SE Asia.

Total 8997

FY 2001 Planned Program:

- 1095 Begin systematic screening of the genomic sequences generated through the Plasmodium sequencing effort to identify additional *P. falciparu*m candidate vaccine antigens.

- 1538 Complete and annotate the genomic sequence of *P. falciparum*. Begin sequencing the *P. vivax* genome.
- 571 Determine unique *P. falciparum* gene targets that could be incorporated into a diagnostic assay to detect drug-resistant parasites. Identify potential populations for field testing a drug for treatment of multidrug-resistant malaria.
- 464 Identify potential components of a combined polyvalent Shigella vaccine.
- 332 Identify the best ETEC candidate components for inclusion in a combined enteric vaccine.

FY 2001 Planned Program: (continued)

- 374 Identify components of candidate Campylobacter vaccines and vaccine approaches that would be compatible with the Shigella and ETEC components of a combined enteric vaccine.
- 315 Identify nucleic acid primers and probes for Shigella, Campylobacter and ETEC that will be compatible with the common diagnostic platform.
- 791 Identify T-cell responses to dengue infection to more completely be able to evaluate efficacy of dengue vaccines.
- 409 Identify a primate model for viral hemorrhagic fever that does not require biosafety level 4 (BL-4) containment.
- 83 Perform surveillance and epidemiology studies to identify field sites for hepatitis E vaccine testing.
- 421 Define the range of natural immunologic heterogeneity among *Orientia* isolates. Clone and sequence appropriate strain specific antigens from appropriate non-crossprotective isolates for use in the development of a polyvalent scrub typhus vaccine. Prepare one or more potential vaccines candidates (e.g., recombinant, DNA) and evaluate their protective efficacy in mice against homologous challenge.
- 257 Clone, express and characterize conserved antigens that are potential components of a multivalent vaccine against Group B *N. meningitidis.*
- 1106 Complete a risk assessment of chigger and tick-borne diseases. Complete establishment of a system for worldwide surveillance of insecticide resistance.
- 878 Devise processes for manufacture of at least 10 new vaccine lots under cGMP compliance.
- 572 Characterize and evaluate correlates of immunity in nonhuman primate and human infection with hantavirus. Conduct surveillance for hantaviruses in South America and SE Asia.

Total 9206

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BS14

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS14 Science Base/Combat Casualty Care Research	3704	3664	3972	4056	4143	4701	5360	5640	Continuing	Continuing

Mission Description and Justification: This project conducts research to understand the basic mechanisms of combat-related trauma. This research identifies trauma-related topic areas for exploratory techniques and the experimental models necessary to support in-depth trauma research studies. This research is the basis for the development of trauma treatment and surgical procedures to extend the time of death due to bleeding following trauma 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.

FY 1998 Accomplishments:

200	Began tests of the feasibility of a microwave warming catheter for intravenous resuscitation of hypothermic casualties.
1556	Evaluated feasibility of medical decision assist algorithms to enhance first responder capabilities in the diagnosis and treatment of casualties.
374	Continued microbiological surveillance of burn victims to aid in identifying, tracking, and reducing infections.
750	Examined molecular mechanisms that contribute to ongoing central nervous system damage after brain trauma.
200	Evaluated small volume resuscitation fluids as a therapy for massive pre-hospital hemorrhage.
200	Measured cytokine gene activation in tissues after hemorrhagic shock to identify possible therapeutic targets.
200	Evaluated antimicrobial modalities to prevent and treat burn-associated chondritis.
224	Established human bronchial epithelial cell culture system to examine compounds protective against smoke injury.
Total 3704	

FY 1999 Planned Program:

482	Research to extend the liquid storage time-span of red blood cells to enhance far-forward blood supplies.
200	Investigate the efficacy of a hemostatic dressing designed to stanch massive bleeding in combat casualties.
625	Evaluate pharmaceutical treatments designed to counter central nervous system injury after trauma and to minimize secondary brain damage.
400	Investigate an anti-caries vaccine to reduce dental casualties far-forward.
535	Investigate microarray gene analysis methods to assess cytokine contribution to secondary tissue damage that occurs after trauma.
32	Establish cell culture system to test antisense DNA directed against bronchial epithelial mucus genes to block the hypersecretion of mucus that occurs after smoke inhalation.
285	Investigate methods for the diagnosis and repair of extremity injuries including bone, blood vessels, and skin.
183	Verify the sensitivity of non-invasive sensors designed to monitor physiological parameters for the diagnosis and treatment of casualties.
849	Research into fundamental aspects of severe hemorrhage to determine requirements for aggressive resuscitation.
73	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences
	PROJECT: BS14

Total 3664

FY 2000 Planned Program:

400	Continue refinement of an anti-caries vaccine to reduce dental casualties far-forward.
844	Investigations to determine the degree of resuscitation that is optimal after severe hemorrhage.
414	Research into the diagnosis and treatment of blast, behind armor, and other blunt trauma.
200	Investigate methods to detect pneumothoraces in casualties in a noisy, far-forward environment.
200	Investigate receptor-specific analgesia and pain relief to increase return to duty capabilities far-forward.
40	Screen antisense DNA against mucin genes for ability to inhibit the excess mucus secretion that occurs after smoke inhalation.
599	Continue evaluating pharmaceutical treatments to reduce the central nervous system injury that continues to occur after an initial trauma.
774	Evaluate in vivo models to assess the efficacy of pharmacologic therapies designed to reduce or block ischemia-reperfusion injury that occurs after resuscitation from severe hemorrhage.
501	Compare efficacy of competing methods that are used to prepare plasma products with enhanced shelf lives.

Total 3972

FY 2001 Planned Program:

	400	Screen anti-caries vaccines in appropriate test models.
•	850	Continue research into optimal resuscitation protocols to treat casualties after severe hemorrhage.
•	422	Continue research into the diagnosis and treatment of blast, behind armor, and other blunt trauma.
•	200	Compare computerized algorithms that integrate sensor inputs to allow far-forward detection of pneumothoraces.
•	200	Continue investigations into receptor-specific analgesia and pain relief to increase return to duty capabilities far-forward.
•	100	Test antisense DNA directed against mucin genes for ability to inhibit excess mucus secretion in smoke-exposed bronchiolar tissue.
•	600	Continue evaluating pharmaceutical treatments to counter central nervous system injury that occurs after an initial trauma.
•	784	Continue to evaluate in vivo models to assess efficacy of pharmacologic therapies directed against ischemia-reperfusion injury that occurs after resuscitation from severe hemorrhage.
•	500	Screen second generation plasma products that incorporate improvements in stability and weight in animal models to assess safety and efficacy.

Total 4056

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BS15

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS15 Science Base/Army Operational Medicine Research	4990	9341	5378	5508	5640	7351	8286	8572	Continuing	Continuing

Mission Description and Justification: The scientific and technical objectives for this project focus 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 non-ionizing radiation, directed energy, blast, jolt, vibration, noise, and toxic industrial chemicals as environmental contaminants are also investigated under this project. Specific tasks include delineating injury and effect thresholds, mechanisms, and sites of action. Emphasis is on protection, sustainment, and enhancement of the physiological and psychological capabilities of military personnel under combat operations in all environments. The six main thrust areas include neuromodulation of stress and cognition, metabolic regulation, control of regional blood flow, oxidative stress interventions, tissue remodeling/plasticity, and biomechanical/biodynamic mechanisms of injury. A portion of this research supports the Science Research Objective (SRO) on "Enhancing Soldier Performance."

FY 1998 Accomplishments:

- 908 Discovered suppression of immunological responses to vaccination (Hep A vaccine) in Army Ranger students subjected to multiple stressors in training.
- 377 Discovered that high fat diets worsen the effect of stress on immune function parameters (lymphocyte proliferation) in a rodent model.
- 100 Demonstrated that exposure to extreme heat stress increases intracellular levels of calcium in isolated human endothelial cells via influx from the external medium.
- 250 Demonstrated that blood platelets in soldiers following 2 hours of cold exposure have a decreased sensitivity to activation by adenosine diphosphate.
- 215 Investigated temperature pill technology to quantify body heat balance during body heating and cooling.
- 242 Determined relationship of melatonin to prolactin and gonadotropins and confirmed absence of adverse effects on the female reproductive system.
- 753 Identified candidate suite of biomarkers for assessing redox status and evaluated role of oxidative stress on pathogenesis of inhalation of particulates.
- 200 Proposed a preliminary model to predict incapacitation resulting from toxic combustion gases in enclosed space for use in crew casualty/soldier survivability assessments.
- 150 Confirmed hypothesis that a brain neurotransmitter precursor, tyrosine, could reduce stress and improve mental performance in female soldiers in stressful conditions (e.g., cold and hypoxia).
- 225 Discovered that sleep deprivation impairs performance by deactivating brain areas mediating alertness, attention, and complex task performance.
- 110 Characterized the role of thickness of skin, clothing, and soft and hard body armor in enhancing or reducing injury to the thorax.
- 175 Determined optimal biomechanical properties of backpack loads (e.g., center of mass and pressure point studies) necessary for optimal design of the Land Warrior and other load carriage systems.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BS15

FY 1998 Accomplishments: (continued)

- 375 Determined fatigue-based operational criteria for head-supported mass in female aviators and developed biodynamic simulation to confirm injury-based helmet weight design criteria.
- 200 Overcame a technological barrier to visual performance testing with invention of a new test, the Small Letter Contrast Test, with broad applications.
- 350 Demonstrated adaptive ocular response mechanisms that underlie the natural recovery of visual acuity after relatively mild laser-induced foveal lesions.
- 360 Determined mechanism of near-infrared laser-induced retinal injury that will support development of soldier safety criteria for the MILES 2000 weapons simulators.

Total 4990

FY 1999 Planned Program:

- 850 Explore effects of an amino acid dietary supplement on muscle metabolism and strength following a protracted resistance exercise training program in women (SRO).
- 400 Characterize energy substrate metabolism and performance benefits from consumption of a solid carbohydrate supplement in intensive field training (SRO).
- 760 Identify urinary markers for stress fracture and bone remodeling in men and women undergoing recruit training (SRO).
- 550 Evaluate the effects of significant hypothermia and rewarming on vascular permeability and reticuloendothelial function in a rat model of human hypothermia (SRO).
- 441 Quantify the effects of marked hyperthermia on extravasation and reticuloendothelial function in a validated rat model of human heat injury (SRO).
- 170 Evaluate and review vertebrate chemoreceptor oxygen sensing mechanisms, adaptation to altitude, and potential for novel bioengineered oxygen sensing applications.
- 381 Explore use of nonmammalian vertebrate models and new redox measures for evaluation of individual soldier susceptibility to oxidative stress.
- 350 Characterize psychoneuroendocrine stress responses in stressful special operations military training scenarios.
- 280 Characterize significant pulmonary, gastrointestinal and brain cellular, biochemical, and functional changes after blunt trauma.
- 500 Identify acute retinal vascular and neuronal injury mechanisms for advanced treatment of battlefield laser eye injuries.
- 486 Explore effects of treatment in cultured human cells to assist in selecting therapeutics for laser eye injury prevention and treatment.
- 225 Explore feasibility of EEG-based analysis to distinguish restorative from non-restorative sleep (SRO).
- 200 Validate newly selected tests of visual performance by correlation of macular disease, glaucoma, and diabetic retinopathy with digital imaging, the Small Letter Contrast Test, and the color acuity test.
- 3549 Conduct Congressionally mandated program of nutrition research support including metabolic laboratory studies and field assessments of the adequacy of operational rations.
- 199 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
	PROJECT BS15

Total 9341

FY 2000 Planned Program:

- 869 Define energy requirements of men and women in various categories of jobs on Navy ships and during Army field training.
- 602 Determine the ability of vitamin/anti-oxidant supplements to prevent or improve recovery from over-use muscle injury or preserve lean body mass during sustained operations (SRO).
- 650 Identify biochemical mechanisms and functional consequences of overtraining in soldiers with prolonged physical exertion and other operational stress (SRO).
- 500 Investigate mechanisms of heat acclimation strategies to optimize thermoregulation and tissue protection.
- 450 Investigate the mechanisms of various interventions (hypertonic saline/dextran and flunarizine) to reduce hypothermia and rewarming injury in a rat model of human hypothermia (SRO).
- 600 Determine noninvasive neuroendocrine markers of mental performance (marksmanship, sensory processing, attention and vigilance) in an operationally stressful environment.
- 225 Identify predictors of operational task performance with sleep deficit based on the relative contribution of a learning component, using data from human sleep dose study (SRO).
- 600 Explore new oxidative stress assessment technologies for use in hazard sensors for environmental and medical surveillance.
- 500 Explore adaptive strategies of humans to laser exposure for inclusion in laser battlefield models and a virtual reality training system for soldiers.
- 382 Explore novel combination strategies (early and late phase) for treatment of laser-induced retinal injury inherent to battlefield lasers.

Total 5378

FY 2001 Planned Program:

- 860 Explore approaches to reduce metabolic water requirements through thermoregulatory and osmoregulatory mediators (SRO).
- 300 Explore feasibility of modifying chemoreceptor oxygen sensing to simulate altitude to accelerate acclimation in hypoxia (SRO).
- 710 Discover new biomedical code appropriate to modeling biophysical properties of human tissues ranging from finite elements models of rigid structures through viscoelastic interfaces to fluid dynamics properties for use in injury sciences models.
- 760 Explore feasibility of nerve cells maintained on an electronic matrix to act as an electronic “canary” for detection and exposure monitoring of neurotoxic industrial and agricultural chemicals.
- 200 Investigate the effects of caffeine and/or ephedrine on metabolic rate and performance in cold environments (SRO).
- 250 Evaluate and quantify the efficacy of cytokine antagonists as prophylaxes/therapies to heat injury/illness.
- 200 Identify and quantify the role of cytokines and other cellular mediators in sleep deprivation and extreme fatigue generated in adverse environments.
- 257 Discover mechanisms of stress fracture and the relationship to bone mineral density to determine if stress fracture incidence can be reduced through interventions to enhance bone mineral accretion (SRO).

- 250 Explore relationship between sleep deprivation and performance using PET scan brain imaging technologies (SRO).
- 561 Assess potential therapeutics against blast-induced neuronal damage in animal models.
- 350 Investigate pharmacological intervention strategies to enhance cognitive and psychomotor performance in an operationally stressful environment.

FY 2001 Planned Program: (continued)

- 810 Explore novel combination strategies (early and late phase) for treatment of laser-induced retinal injury inherent to battlefield lasers.

Total 5508

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BS17

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS17 Molecular Biology/Military HIV Research	412	397	435	441	448	485	648	667	Continuing	Continuing

Mission Description and Justification: This project provides for basic research for early diagnosis and identification of technologies to design prevention and treatment of HIV. The present emphasis is on identification and comparison of HIV strains from many geographical locations, characterization of etiologic agents and definition of tests for epidemiological surveys to design a vaccine to prevent disease. Current policy prohibits OCONUS assignments of antibody positive service members. A safe and effective vaccine for prevention of infection and intervention will permit all service members to become worldwide deployable.

FY 1998 Accomplishments:

- 412 Demonstrated induction of neutralizing antibody against heterologous viral isolates and protection from challenge with heterologous viral isolates of HIV in rhesus macaque monkeys using a candidate vaccine consisting of oligomeric glycoprotein 140, administered in high and low dosages. Continued refinement of multimeric as a human immunogen by performing studies to stabilize and prepare the immunogen for human use. Conducted surveillance of HIV among commercial sex-workers (CSW) in Peru, prevalence approximately 1.3%. Conducted genotyping of 169 clinical HIV isolates. Detected first non-subtype B HIV in Peru, further demonstrating the widespread appearance of multiple genotypes, an important consideration in vaccine development and fielding and, perhaps, for prevention among US forces. Completed the Shipboard Sexual Risk Survey of US military service members deployed to South America. Demonstrated frequent (37%) sexual contact by service members but also showed high frequency of condom use (90%).

Total 412

FY 1999 Planned Program:

- 386 Identify complex protein (oligomeric) candidates for vaccines. Characterize the immune response against oligomeric protein vaccine candidates. Explore DNA vaccine candidates.
- 11 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 397

FY 2000 Planned Program:

- 435 Evaluate the importance of HIV genotypes in predicting HIV immunotypes necessary for inclusion in an HIV vaccine. Define the correlates of immunity to HIV, necessary for vaccine design. Establish genetic and phenotypic correlates of drug resistance among HIV-1 clinical isolates, necessary for establishing drug treatment strategies for military dependents.

Total 435

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
	PROJECT BS17

FY 2001 Planned Program:

•	441	Evaluate new methodologies for exploration of HIV drug resistance mechanisms outside the pol gene.
Total	441	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: BS19

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS19 Telemedicine Soldier Status Research	0	465	615	624	635	614	677	709	Continuing	Continuing

Mission Description and Justification: The purpose of this program is to perform research contributing to superior combat casualty care for troops through faster diagnosis and treatment while allowing on-site health care providers to consult with specialists worldwide. This work will focus on developing the means to determine soldier physiological status and aiding medical diagnosis and treatment. A significant thrust area will work to ascertain the sensors most relevant to determine change in soldier physiological status.

FY 1998 Accomplishments: Project not funded in FY 1998

FY 1999 Planned Program:

- 360 Conduct analysis and validation of requirements for telesurgical mentoring technology.
- 92 Conduct research in Web-based consultation for dermatology and other medical specialties (e.g., pathology, echo cardiography).
- 13 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 465

FY 2000 Planned Program:

- 66 Develop the transmission and reception capability for the prototype high resolution digital stereoscopic video biomicroscope.
- 86 Investigate efficacy of various portable and hand-held medical imaging devices, including 3D ultrasound.
- 162 Conduct research on predictive diagnostics for computer-assisted critical care and medical decision support.
- 124 Conduct research in medical robots with improved control and functionality for telepresence surgery.
- 97 Continue research in Web-based consultation for dermatology and other medical specialties (e.g., pathology, echo cardiography).
- 80 Explore technologies that enable prognostic critical care decision support and autonomous life support systems (e.g., sensor fusion algorithms).

Total 615

FY 2001 Planned Program:

- 215 Continue research on predictive diagnostics for computer-assisted critical care and medical decision support.
- 180 Continue research in medical robots with improved control and functionality for telepresence surgery.
- 120 Continue research in Web-based consultation for dermatology and other medical specialties (e.g., pathology, echo cardiography).
- 109 Continue to explore technologies that enable prognostic critical care decision support and autonomous life support systems (e.g., sensor fusion algorithms).

	DATE **February 1999**
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601102A Defense Research Sciences**

Total 624

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AT22

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AT22 Soil and Rock Mechanics	1798	1802	1869	1898	1929	2197	2546	2619	Continuing	Continuing

Mission Description and Justification: Basic research in this project develops the fundamental knowledge base required by the Army in the field of civil engineering. Current emphasis is on: defining the constitutive behavior and penetration mechanics (including plastic deformation and microfracture mechanics) associated with projectile impact on complex geologic and structural materials; development of mathematical models needed for first principle analyses of explosive-induced ground shock and high-velocity projectile impact; development of analytic models and advanced construction materials for the design and construction of permanent or expedient operating surfaces both within CONUS and within a theater of operations; development of adaptive or responsive construction materials suitable for camouflage, concealment, and deception measures for fixed or semi-fixed assets; and determining and quantifying the non-linear, hysteretic response of deformable soils to transient loadings resulting from high-speed curvilinear vehicle maneuver. These technologies provide the basis for applied research to provide: analytical capabilities for mobility assessments; hardened battlefield positions, fixed facilities, and semi -fixed assets; multispectral camouflage, concealment, and deception for fixed facilities; and advanced vertical and horizontal construction materials in PE 0602784A, Project AT40.

FY 1998 Accomplishments:

- 1798 - Developed improved 3D projectile trajectory code that predicts turning during shallow impact and projectile damage .- Evaluated responsive materials and selected natural color combinations.
  - Evaluated models for predicting the durability and dynamic behavior of pavement materials.
  - Exploited aggregate soil theory to model vehicle plowing performance; conducted experiments in Army centrifuge to collect patterns of soil response to wheel loadings.

Total 1798

FY 1999 Planned Program:

- 1754 - Complete first-principle code calculations simulating oblique-impact long-rod penetration tests against concrete targets.
  - Incorporate selected responsive/passive materials into/onto substrate host.
  - Complete analytical models for predicting traffic distribution, cohesive soil moisture response, and compaction behavior.
  - Develop analytic model describing influence of partial soil saturation on surface shear strength.
- 48 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1802

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: AT22

FY 2000 Planned Program:

•	1869	- Incorporate projectile erosion algorithms into penetration prediction codes. - Determine appropriate combinations of responsive/passive composite materials for camouflage, cover, and deception (CCD) as a function of environment and facility. - Develop theoretical formulation for penetration of wheels into partially saturated soils during cross-country movement (2Q00-4Q00) - Verify constitutive models for asphalt pavement materials and implement constitutive models for granular materials into an advanced pavement system model.
Total	1869	

FY 2001 Planned Program:

•	1898	- Develop finite element interface algorithms for response of target joints and fractures to projectile penetration. - Develop experimental quantity of responsive/passive CCD material. - Model soil response to transient loading patterns of wheeled and tracked vehicles. - Evaluate pavement interface, load, dynamic response, and traffic distribution models. - Determine physics of fiber-soil interaction that facilitates increased soil stability.
Total	1898	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AT23

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AT23 Basic Research/Military Construction	1427	1564	1579	1605	1630	1907	2209	2271	Continuing	Continuing

Mission Description and Justification: This project supports development of fundamental knowledge essential to develop the leap ahead technologies required to solve Army and Defense (via Project Reliance) unique problems in the planning, programming, design, construction, and sustainment of force projection platforms and energy and utility infrastructure to achieve the infrastructure cost reduction goals of the current national military strategy. This project supports exploratory development efforts in Program Element 0602784A, Projects AT41 and AT45. This project has significant dual-use application potential.

FY 1998 Accomplishments:

- 1427 - Developed engineer interaction protocols, common facility component representations, and facility knowledge sharing algorithms to enable the development of an open, collaborative engineering design system.
  - Developed an understanding of active magnetostrictive tagging of construction materials for monitoring structural health of large concrete structures.
  - Continued development of an understanding of full 3-D behavior of steel building systems via testing at a triaxial shock test facility.

Total 1427

FY 1999 Planned Program:

- 1523 - Develop collaborative engineering methodologies to enable asynchronous design and engineering of facilities.
  - Characterize Electrical Time-Domain Reflectometry (ETDR) for evaluation of structural health of large concrete structures.
  - Continue 3-D response analysis of steel buildings for seismic safety.
  - Develop concepts for magnetostrictive patch structural health monitoring systems.
- 41 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1564

FY 2000 Planned Program:

- 1579 - Fundamental understanding of the behavior of structural connections under high cyclic loads (like earthquakes).
  - Characterization of post-elastic responses of frame and shear walls to tri-directional earthquake loading.
  - Models for determining structural health using ETDR techniques.

Total 1579

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
	PROJECT AT23

FY 2001 Planned Program:

•	1605	- Develop theory for collaborative axiomatic designs. - Develop and test models for force development in shape memory alloy (SMA) pre-/post-tensioned systems. - Evaluate principles for infrastructure applications of functionally gradient materials systems that are multiple function layerwise systems that can perform multiple sensor/actuator functions over a finite distance.
Total	1605	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: AT24

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AT24 Snow, Ice and Frozen Soil	1357	1157	1166	1184	1204	1410	1627	1673	Continuing	Continuing

Mission Description and Justification: This project is the only focused DoD basic research program investigating the physical, chemical, and electrical properties of snow, ice, and frozen soil and characterization of dominant winter and cold regions processes impacting military materiel, operations, and facilities. It provides the knowledge base for exploratory development to support modeling and simulation and product improvements as well as leading to reduced life-cycle costs and increased readiness and operability in extreme cold, high altitude and seasonal winter conditions around the world. Products are directly input to PE 0602784A, Project AT42, as well as Navy and Air Force science and technology efforts, and form the basis for much civilian applied research in these areas. It provides the fundamental knowledge base for developing concepts and approaches to upgrade materiel and doctrine for more effective performance in these challenging conditions.

FY 1998 Accomplishments:

- 1357 - Quantified the rapid and dynamic evolution of millimeter wave radar response in temperate snow conditions.
  - Parameterized role of snow cover in turbulent exchange of heat and moisture in boundary layer.
  - Quantified dominant acoustic propagation processes for mapping snow covered terrain.

Total 1357

FY 1999 Planned Program:

- 1126 - Develop vectorized seismic wave propagation code for viscoelastic/porous media.
  - Develop computer model to analyze ice properties derived from satellite microwave footprints.
  - Develop procedures for mapping regional atmospheric icing.
- 31 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1157

FY 2000 Planned Program:

- 1166 - Investigate small-scale heterogeneity for state-of-the-snow/ground modeling.
  - Analyze spatial variability of icing processes relevant to communications and air operations.
  - Determine efficiency of snow as a filter for chemical particulates.

Total 1166

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences
	PROJECT: AT24

FY 2001 Planned Program:

•	1184	- Develop model for parameterizing turbulent energy exchange over snow.
		- Develop statistical characterization of ice thickness relevant to winter operations.
		- Broaden understanding of snow friction processes relevant to military operations.
Total	1184	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BT25

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BT25 Environmental Research - Corps of Engineers	4209	4135	4458	4530	4601	5042	5134	5343	Continuing	Continuing

Mission Description and Justification: This project provides the basic research needed to develop the technologies to address Army issues in the restoration, compliance, conservation, and pollution prevention areas. The focus in restoration provides the basic knowledge needed to develop physical, chemical and biological technologies to clean up the Army's contaminated sites. In compliance and pollution prevention, efforts address knowledge gaps vital to maintaining compliance and preventing pollution at non-industrial installations. The focus in conservation is on landform and ecological modeling, the feasibility of development and propagation of resilient plant species for rehabilitation of damaged lands, and fundamentals of training and test activity noise as they might be applied to reducing adverse effects on mission activities. This project will also examine the underlying requirements for comprehensive environmental modeling and simulation products to address environmental issues. The project supports applied research under PE 0602720A, Projects AF25, D048, and A896. Sixty-five percent (65%) of the funds in this project are used to support extramural research via a Broad Area Announcement requesting work supporting in-house laboratory efforts.

FY 1998 Accomplishments:

- 2950 - Identified fundamental biogeochemical processes affecting cryptogamic succession. (U.S. Army Construction Engineering Research Laboratories – CERL)
  - Developed an integrated hillslope and channel evolution model as an investigation and prediction tool. (CERL)
  - Completed dynamic visualization methodology to support erosion and landscape process simulations. (CERL)
  - Continued experiments to identify reaction mechanism and pathway for electrochemical reduction of energetic compounds in water. (CERL)
  - Initiated experimental design for photocatalytic destruction of nitroaromatic compounds. (CERL)
- 1259 - Expanded this project to provide the basic knowledge needed to develop physical, chemical, and biological technologies to clean up Army contaminated sites; to maintain compliance and prevent pollution at Army installations; to complete validations and scaling comparisons and transition to site assessment and restoration programs and to conduct landform and ecological modeling. These efforts included:
  - Exploration of innovative site characterization sensor technologies. (U.S. Army Waterways Experiment Station - WES)
  - Investigations of fundamental effects of complex media/contaminant interactions on sensor responses to include UXO detection. (WES)
  - Developing mathematical formulations for multi-contaminant groundwater transport mechanisms and analyze characteristics in heterogeneous media. (WES)
  - Investigating bio-geochemical processes at low/freezing temperatures with quantified rates of activity and suppression/ stimulation. (U.S. Army Cold Regions Research and Engineering Laboratory – CRREL)
  - Investigations of chemical conjugates and other intermediate byproducts during biological degradation of explosives in soil using cold-adapted organisms. (CRREL)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BT25

FY 1998 Accomplishments: (continued)

- A program to investigate the fundamentals of electromagnetic induction spectroscopy (WES) and pan-spectral electromagnetic sensing (CRREL) to support enhanced discrimination and identification of buried unexploded ordnance.
- Programs to obtain the fundamental mechanisms of biostabilzation of polycyclic aromatic hydrocarbons (PAHs) under denitrification conditions in sediment and of reduce and bind phenomena of explosives. (WES)
- A program to explore the phenomenology to support the prediction of interfacial properties and multiphase soil hydraulic properties using computational molecular thermodynamics. (CRREL)

Total 4209

FY 1999 Planned Program:

- 2076 - Explore fundamentals of physical/chemical response of unexploded ordnance on candidate detection sensors. (WES)
  - Improve theory, scaling, and computational tools for simulating fate and transport of contaminants in groundwater. (WES)
  - Explore fundamentals of organic compound fate in freeze-thaw environments and combined biological/geochemical/geophysical measurement and detection. (CRREL)
  - Develop kinetic and mechanistic understanding of sonochemical destruction of nitro containing compounds. (CERL)
  - Determine plant varieties with improved resilience to military traffic and suitable for revegetation of training lands. (CERL)
- 1950 - Complete description of major biological degradation pathways of major explosives types; e.g., contaminants and media. (WES)
  - Combine low-temperature, bio-geochemical fate of mixed organics and metals with discontinuous permafrost models. (CRREL)
  - Establish cause/effect relationship of military stressors and ecosystem responses. (WES)
- 109 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 4135

FY 2000 Planned Program:

- 2180 - Continue investigation of photocatalytic destruction mechanisms for nitroaromatic compounds. (CERL)
  - Investigate interrelationship between changes in soil microbial composition and plant succession dynamics. (CERL)
  - Examine chemical and biological indicators to measure the succession productivity of biological crusts. (CERL)
  - Develop experimental protocol to test bi-stable system using mathematical models. (CERL)
- 1670 - Complete investigation of the fundamentals of electromagnetic induction spectroscopy (WES) and pan-spectral electromagnetic sensing (CRREL) to support enhanced discrimination and identification of buried unexploded ordnance.
  - Continue description of the fundamental mechanisms of biostabilzation of polycyclic aromatic hydrocarbons (PAHs) under denitrification conditions in sediment and "reduce-and-bind" phenomena of explosives. (WES)
  - Continue the determination of adsorption and transformation mechanisms in low carbon aquifer soils. (WES)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: BT25

FY 2000 Planned Program: (continued)

- 600 - Develop a program to determine the basic processes necessary to optimize explosive degradation using molecular breeding and computer-aided engineering. (WES)
- Develop a program to explore the basic principles of neutron activation of munitions using high pressure xenon gamma ray detectors. (WES)
- Complete description of major biological degradation pathways of major explosives types using cold-adapted organisms. (CRREL)
- Complete the determination of the phenomenology for predicting NAPL interfacial properties and multiphase soil hydraulic properties using computational molecular thermodynamics. (CRREL)
- Develop a program to explore inversion techniques for 3D permafrost delineation. (CRREL)

Total 4450

FY 2001 Planned Program:

- 2258 - Determine effects of soil microbial composition on decomposition, mineralization and nutrient availability, and ultimately succession dynamics. (CERL)
- Develop methods to quantify biogeochemical indicators of the health of biological crusts. (CERL)
- Develop model for photo degradiation pathways for the destruction of nitro compounds using photo catalytic oxidation.. (CERL)
- 1922 - Complete description of the fundamental mechanisms of biostabilization of polycyclic aromatic hydrocarbons (PAHs) under denitrification conditions in sediment and of "reduce and bind" phenomena of explosives. (WES)
- Finalize the determination of adsorption and transformation mechanisms in low carbon aquifer soils. (WES)
- Continue the determination of the basic processes necessary to optimize explosive degradation using molecular breeding and computer-aided engineering. (WES)
- Continue exploring the basic principles of neutron activation of munitions using high pressure xenon gamma ray detectors. (WES)
- Establish a program to explore the basic principles of separation and identification of metabolites of nitramine munitions produced by current remediation technologies. (WES)
- Establish a program to investigate the basic factors affecting ground penetrating radar (GPR) performance and their use in helping map terrain subsurface anomalies. (WES)
- Institute a study to understand the basics of visible and near-infrared computed tomographic imaging spectropolarimetry for rapid UXO detection. (WES)
- Conduct an investigation of the fundamental mechanisms of the stabilization and accumulation of heavy metals by aquatic and terrestrial plants. (WES)
- 350 - Complete the exploration of inversion techniques for 3D permafrost delineation. (CRREL)
- Establish a program for delineating biotic and abiotic mechanisms for plant-induced attenuation of explosives and organics. (CRREL)

Total 4530

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: A305

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A305 Automatic Target Recognition Research	1110	1019	1174	1207	1239	1377	1528	1585	Continuing	Continuing

Mission Description and Justification: This project focuses on the development of the fundamental underpinnings for aided and automatic target recognition capabilities for land warfare scenarios (primarily characterized by low depression angle, relatively short range and highly intense competing clutter backgrounds). Electro-optic/infrared (EO/IR) imaging systems utilizing advanced algorithms for interpreting and recognizing targets over extended battlefield operating conditions are essential for the warfighter. This project will develop fundamental capability to predict, explain and characterize target and background content. These efforts are aimed at evaluating the complexity and variability of target and clutter signatures and, ultimately, utilize that knowledge to conceptualize and design advanced Automatic Target Recognition (ATR) paradigms to enhance robustness and effectiveness. These ATR strategies include utilization of emerging sensor modalities such as spectral imaging and multi-sensor approaches. These research findings support several technology efforts including multi-domain smart sensors, third generation forward looking infrared (FLIR), advanced multi-function ladar, and advanced technology demonstrations (ATD) such as Multi-Function Staring Sensor Suite, Target Acquisition, and Joint Combat Identification. Research will also be conducted in the area of acoustic sensors, which can provide very low cost target detection capabilities.

FY 1998 Accomplishments:

- 1110 - Developed high resolution ladar signature prediction model
  - Trained target recognizer using model results and tested on measured data
  - Conducted principal components analysis on 8-12 micron imagery and developed clutter rejector based on that concept
  - Created several hundred synthetically generated 8-12 micron infrared images to use in validation efforts

Total 1110

FY 1999 Planned Program:

- 1006 - Undertake thermal measurements in laboratory conditions on canonical shapes and compare with model predictions.
  - Utilize existing target modeling capability to generate multiple instances and compare with measured signatures.
  - Evaluate the phenomenology differences of co-registered 3-5 micron thermal images with 8-12 micron counterparts.
  - Extend 8-12 micron IR ATR algorithms to the 3-5 regime.
  - Develop innovative new approaches to acoustic beamforming and target identification.
- 13 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1019

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: A305

FY 2000 Planned Program:

•	1174	- Assess quality of thermal prediction for various scenarios (e.g., underground mines, etc.) - Isolate high and low false alarm rate images from IR data base and compute metrics of image complexity. - Conduct phenomenological studies of multi-spectral data to develop preferred operating bands for land warfare scenarios. - Develop a matching pursuits detection paradigm to accumulate evidence of primitive sub-elements of target emissions. - Conduct initial survey of hyperspectral data (both infrared and visible) and its applicability to land warfare missions.
Total	1174	

FY 2001 Planned Program:

•	1207	- Assess fidelity of thermal predictions for background data; improve model as indicated. - Correlate performance of one or more modern IR ATR algorithms with image complexity measures. - Based on measured phenomenon recommend preferred operating wavelengths for broadband mid and long wave thermal imagers. - Conduct phenomenological studies of hyperspectral data to assess minimum number of bands to achieve high discrimination performance at an affordable price for land warfare scenarios.
Total	1207	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: A31B

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A31B Infrared Optics Research	2202	1998	2341	2421	2504	2893	3121	3259	Continuing	Continuing

Mission Description and Justification: This project sustains the Army's theoretical and experimental research in night vision and electro-optic technologies. It generates new technology to obtain unprecedented awareness of the battlefield to continue to "own the night," notwithstanding increased foreign competition. To achieve these objectives, focal plane arrays (FPAs) with significantly improved performance for major platforms, laser radar (ladar) techniques that can utilize those FPAs, and low cost night vision aids that allow for wide distribution will be required. Therefore, research is focused on materials, devices and techniques required for the development of high performance smart dual color staring infrared focal plane arrays (IRFPAs), innovative ladar architectures, and uncooled IRFPAs with moderate performance. For the high performance IRFPAs mercury cadmium telluride (HgCdTe) detector arrays and quantum well infrared photon detector (QWIPs) are investigated. Ladar research is focused on FM/cu techniques that permit high-resolution but low frequency range readout. Research for uncooled IRFPAs is based on development and analysis of thin film ferro-electric materials and novel detector architectures with improved thermal isolation structures. Uncooled IRFPAs will also have significant civilian applications.

FY 1998 Accomplishments:

- 1093 - Demonstrated improved quantum efficiency in QWIP detector array with coupled well structure.
- 435 - Demonstrated dual color QWIP array.
- 674 - Analyzed level impurities and dopants in II-VI semiconductor materials for advanced sensors.

Total 2202

FY 1999 Planned Program:

- 592 - Demonstrate 1.5 *u*m quantum well modulator for ladar.
- 1401 - Demonstrate advanced thin film ferroelectric structure for low cost uncooled, infrared focal plane arrays (IRFPA) which provide order of magnitude production, maintenance and cost benefits over current models.
  - Determine normal incidence performance of polytype based alignment detector structures.
- 5 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1998

FY 2000 Planned Program:

- 2341 - Demonstrate high power 1.5 *u*m diode laser and quantum well modulator/mixer for ladar with 600 MHz bandwidth.
  - Design and fabricate low cost uncooled IR detector array.

Total 2341

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999	
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences	PROJECT A31B

FY 2001 Planned Program:

•	2421	- Investigate material growth and device design for LWIR FPA operating above 100^{o}K. - Investigate design for IRFPA to be utilized for active and passive imaging.
Total	2421	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: B52C

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
B52C Mapping and Remote Sensing	2026	2284	2305	2342	2379	2785	3236	3328	Continuing	Continuing

Mission Description and Justification: This project supports research in fundamental topographic sciences 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. The research provides the theoretical underpinnings for Program Element 0602784A, Project A855.

FY 1998 Accomplishments:

- 2026 - Developed terrain feature extraction protocols from integrated Multispectral/Hyperspectral/IFSAR imagery.
  - Devised neural network image data classification capability.
  - Investigated the generation of a vegetation/climate model to map interpolated and inferenced climate terrain inaction data.
  - Defined the critical spatial interrelationships of terrain and threat behavior interrelationships.

Total 2026

FY 1999 Planned Program:

- 2224 - Determine optimal combination of sensor information for generation of topographic data (elevation, feature, and imagery).
  - Evaluate geostatistical wavelet technique for performing image compression.
  - Upgrade climate atmosphere model parameters to enhance tactical decision aids.
  - Explore and prototype methods for automated data capture, characterizing and quantifying models and the dependent relationships across terrain, threat, and military activities.
- 60 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2284

FY 2000 Planned Program:

- 2305 - Investigate multivariate statistical analysis, multivariate interpolation, and enhancements for image analysis.
  - Investigate generating topographic data using a combination of sensor information.
  - Evaluate initial geostatistical models of climatic atmospheric parameters integrated with line-of-sight models for denied areas where limited or no data is available.
  - Evaluate models and their performance to characterize expected battlefield state against actual data sets from operational databases.

Total 2305

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences
	PROJECT: B52C

FY 2001 Planned Program:

•	2342	- Investigate enhancement of neural net and subpixel methods of feature extraction. - Investigate hyperspectral imagery analysis/segmentation. - Devise model to predict precipitation frequency data in the absence of weather data in denied areas. - Investigate the potential to integrate empirical and inductive analysis systems.
Total	2342	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences	PROJECT: B53A

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
B53A Battlefield Environment and Signature	3470	3146	3678	3804	3942	4614	4928	5143	Continuing	Continuing

Mission Description and 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. It impacts Army chemical and biological defense operations, electro-optic and acoustic sensors, smoke/obscurant deployments and target acquisition. This project supports Army Strategic Objectives, provides technology for the Integrated Meteorological System (IMETS) and supports Project Reliance under the Defense Technology Area by providing Tri-Service transport and dispersion research and development. This project is the leader in boundary layer meteorology over land and urban terrain research.

FY 1998 Accomplishments:

- 3470 - Investigated rapid methods for the detection of potentially lethal, low concentrations of harmful bacteria and toxin aerosols; invented highly improved methods for measuring fluorescence of single aerosol particles.
  -Tested and validated the boundary layer model of airflow over complex terrain and within and above vegetative canopies and built-up areas for Army tactical scales.
  - Developed horizontal transilient turbulence theory (an alternative method of describing the effects of turbulence, capable of handling the realistic case of multiscale effects in a single step, substantially reducing computation time), that includes surface layer effects.
  - Completed a prototype acoustic propagation model incorporating complex terrain that was incorporated into a decision aid, providing calculation of acoustic detection probability in realistic environments.
  - Developed theory for sound propagation through large-scale, anisotropic turbulence, including turbulence effects on acoustic target-finding arrays.
  - Developed theoretical and numerical models for sound fields generated by moving targets.
  - Incorporated horizontal radiative transfer techniques into the boundary layer illumination and radiative balance model that improves contrast calculations for target acquisition.
  - Completed an Ultra Violet (UV) and visible wavelength propagation model that includes multiple scattering effects.

Total 3470

FY 1999 Planned Program:

- 3146 - Analyze atmospheric effects on acoustic imaging and coherence using a three-axis orthogonal microphone array.
  - Determine the effects of turbulent intermittency and partial saturation on acoustic target detection and bearing estimation.
  - Develop methods for approximate representation and decomposition of turbulence structure using wavelet and other analyses, and apply to acoustical scattering calculations.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 1 - Basic Research	PE NUMBER AND TITLE: 0601102A Defense Research Sciences / PROJECT: B53A

FY 1999 Planned Program: (continued)

- Complete a set of experiments and theory on the impact of polarization on image propagation in the real and battlefield atmosphere for target acquisition.
- Develop and test a coupled high-resolution meteorological transport and dispersion model.
- Test and validate a coupled 3-D surface boundary layer meteorological model.
- Improve rapid methods for the detection of potentially lethal low concentrations of harmful bacteria and toxin aerosols.
- Develop improved methods of trapping single aerosol particles.
- Evaluate converting the Battlescale Forecast Model (BFM) to a non-hydrostatic model for improvement of severe weather predictions.
- Develop an intermediate scale hydrostatic forecast model to provide BFM with an upgraded capability to depict and forecast mesoscale phenomena not seen in global scale model data.

Total 3146

FY 2000 Planned Program:

• 3678
- Develop methods for discriminating between naturally occurring aerosols and manmade aerosols; develop improved methods of sorting individual aerosol particles.
- Develop theory and numerical models of propagation of sound through inhomogeneous, anisotropic turbulence, including refraction and ground reflections.
- Model and perform experiments on low-frequency acoustic propagation in forest canopies and littoral regions.
- Complete theory and software linking 3-D atmospheric propagation and radiative transfer models to standard interfaces, such as the Total Atmosphere and Ocean Services (TAOS) server, for DoD simulations.
- Couple 2-D surface layer wind model with full 3-D boundary layer meteorological model.
- Couple canopy and urban flow technologies into transport and dispersion models.
- Incorporate detailed Surface Energy Balance in Surface Layer Model.
- Conduct stable boundary layer meteorological field experiment, CASES-99.
- Develop new algorithms for depicting physical processes for better analysis and prediction of icing, low level clouds, and precipitation at time and spatial scales required for accurate quantitative depiction of target area atmospheric conditions.

Total 3678

FY 2001 Planned Program:

• 3804
- Investigate and correct problems with transilient turbulence model.
- Improve boundary layer model by incorporating stable atmospheric conditions.
- Develop 3-D numerical models for acoustic propagation over complex (hilly and mountainous) terrain.
- Model and perform experiments on high-frequency acoustic propagation in forest canopies and littoral regions.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
	PROJECT B53A

FY 2001 Planned Program: (continued)

- Complete a 3-D atmospheric propagation and simulation suite of models that includes the effects of absorption, scattering and radiative transfer, turbulence, clouds, aerosols, and smoke.
- Develop experimental capability for hyperspectral or sensor fusion research with applications for atmospheric propagation.
- Investigate the use of multiple excitation wavelengths and elastic scattering in characterizing aerosol particles.
- Develop new algorithms for depicting physical processes for better analysis and prediction of turbulence, wind shear, and visibility at time and spatial scales required for accurate, quantitative depiction of target area atmospheric conditions.

Total 3804

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
	PROJECT B74A

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
B74A Human Engineering	2453	2248	2607	2685	2766	3175	3446	3586	Continuing	Continuing

Mission Description and Justification: This project supports research on soldier performance, including the areas of visual, auditory, cognitive, and stress-related performance. The objective is to identify, describe and manage underlying human-system interface factors critical to the design of Army weapon systems. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP), and the Army Strategic Research Objectives (SROs).

FY 1998 Accomplishments:

- 2453 - Completed report on the effects of spatial separation on the detection and localization of sound signals presented in noise. Continued to explore the effects of practice and learning on human auditory performance.
  - Continued investigation of hyperstereopsis and its effect on visual perception and depth compression for night vision goggle resolution and field of view design guidelines.
  - Conducted a helmet mounted display field study examining design tradeoffs in information display format and the relative impact on soldier cross-country navigation performance.
  - Continued verification and validation of the noise hazard model with hearing loss data. Delivered beta site versions to NATO Research Study Group (RSG), Medical R&D command, and Society of Automotive Engineers (SAE) Airbag Committee. Conducted field experiment with the previously developed auditory hazard meter to determine user applications.
  - Published report on the effects of stress on voice recognition system efficacy. Conducted studies on the relationship between stress and complex cognitive functioning.
  - Published report on quantification of attentional field of view (FOV) under various divided attention conditions as a predictive measure of driving ability and navigation.

Total 2453

FY 1999 Planned Program:

- 2229 - Complete data collection efforts on human auditory processes in detecting sound in various environments and estimating the distance from the sound source.
  - Publish results of previous studies examining the interaction effects of field-of-view, ocular configuration, and image resolution on task performance using night vision devices in tactical settings; develop draft set of operational metrics for measuring depth perception and visual attention.
  - Publish results of previous helmet-mounted display studies. Develop a model that evaluates changes in soldier performance and workload as a function of changes in display design.

- Develop random incidence corrector and calibration procedures for a "general damage" auditory model. Submit impulse noise standards for Committee on Hearing and Bioacoustics (CHABA) review.

FY 1999 Planned Program: (continued)

- Refine previously developed psychological stress measures and investigate the effects of cognitive skill performance.
- Develop a methodology for studying the role of visual attention in target acquisition.

•	19	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	2248	

FY 2000 Planned Program:

•	2607	- Publish results of previous studies on human auditory perception. - Conduct laboratory study to examine the effects of various colors on task performance using night vision devices. - Develop advanced windows based version of auditory hazard model with active middle ear muscles and azimuthal correction capabilities. - Conduct a field experiment to measure the effects of information availability (timing and frequency) and information accessibility on situational awareness and decision making ability using helmet mounted displays (HMDs). - Investigate the effects of specific battlefield stressors on situational awareness and decision making under conditions of uncertainty. Develop a draft set of operational stress measures. - Examine effects of attentional set and processes of pattern recognition and form perception in terms of soldier target acquisition performance.
Total	2607	

FY 2001 Planned Program:

•	2685	- Investigate the effect of acoustic source motion on human auditory perception. - Refine previously developed operational metrics for measuring depth perception and visual perception to incorporate the effects of color on size and depth cues. - Develop hearing protection algorithms and incorporate into auditory hazard model. - Measure and compare the individual and combined effects of both audio cues and visual presentation of information on task performance using HMDs. - Refine and validate previously developed operational stress measures. - Publish report of findings on the effects of pattern recognition and form perception on target acquisition performance. Begin to examine the effects of target motion on target acquisition and identification.
Total	2685	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

PROJECT: B74F

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
B74F Personnel Performance and Training	2425	2146	2708	2818	2862	2899	2944	3033	Continuing	Continuing

Mission Description and Justification: This project conducts behavioral science research in areas with high payoff opportunities for improved personnel performance and training, including: methods for faster learning and improved skill retention; leader effectiveness for improved team performance; understanding the impact of societal trends on Army readiness; and improving the match between soldier skills and their jobs to optimize performance. Research is also focused on issues of small-team performance, leadership, and training to ensure that personnel performance and training research keep pace with future mission, structural, technological, equipment, and personnel changes. In FY 1998, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), which executes this program, received a one-year Congressional plus-up, reprogrammed from the DOD Defense Health Program (+1500), to this PE/Project, providing funds for short term work on topics including attrition, leadership, new recruit values, assessing command climate, and effects of increased personnel tempo.

FY 1998 Accomplishments:

- 2425 - Developed a set of techniques for improving the retention and generalizability of procedural skills needed in digitized environments.
  - Provided a blueprint and perspective on key Army After Next (AAN) human and organizational issues through national workshops to ensure that personnel performance and training research stay ahead of future changes in force structure and mission requirements.
  - Developed a model of the effects of shared goals and mental models on team performance and the effectiveness of leaders.
  - Completed analysis of the effects of the post-Cold War military situation and conditions on the individual American soldier.
  - Completed research on effects of individual temperament on performance and learning.

Total 2425

FY 1999 Planned Program:

- 2093 - Determine the role of transformational leadership behavior on platoon performance.
  - Develop a model to maximize training effectiveness and efficiency for selected Army tasks, such as topographic map reading.
  - Fully develop a technique to better understand the attitudes of inner-city youth toward Army service.
  - Continue research on the influence of gender/race/ethnic diversity on cohesion, morale, and readiness.
  - Complete research on individual differences in spatial ability and how those differences affect an individual's ability to navigate complex routes.
- 53 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2146

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences
	PROJECT B74F

FY 2000 Planned Program:

•	2708	- Develop models for effective leadership of small, AAN-type units to maximize leader and unit resiliency to adversity. - Analyze Army culture and types of training material to help commanders use that culture effectively. - Complete research on analysis of tacit knowledge and how it contributes to effective leadership. - Model the results of a long-term analysis on the durability of tank gunnery skills in the absence of practice.
Total	2708	

FY 2001 Planned Program:

•	2818	- Complete a model on the effects of electronic communication on the development of trust between subordinates and leaders. - Evaluate the use of latent semantic analysis to assess an individual's knowledge structure and to aid in the automatic analysis of free-range text descriptions. - Continue research on cohesion, morale, and performance effectiveness, particularly as affected by different types of missions and gender issues. - Continue research on the learning, durability, and transferability of trained skills required for the digital environments.
Total	2818	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	43733	44839	47066	48024	49268	49858	51969	54689	Continuing	Continuing
BH50 Telecommunications Research	9656	9073	9668	9821	9978	10459	10947	11483	Continuing	Continuing
BH53 Advanced Distributed Interactive Simulation Research	554	1923	1186	1202	1222	2393	2567	2691	Continuing	Continuing
BH54 Advanced Sensors Research	9871	9257	9865	10022	10182	10672	11249	11817	Continuing	Continuing
BH56 Advanced Displays Research	4351	4416	5896	5992	6087	6251	6635	6996	Continuing	Continuing
BH59 University Centers of Excellence	3964	4247	6262	6568	7147	5284	5581	5914	Continuing	Continuing
BH62 Electromechanics and Hypervelocity Physics	9041	8669	6905	7006	7128	6404	5701	6102	Continuing	Continuing
BH64 Materials Center of Excellence	1736	2221	2434	2472	2511	2560	2761	2925	Continuing	Continuing
BH65 Microelectronics Center of Excellence	1853	2314	1973	2005	2037	2667	2858	3021	Continuing	Continuing
BH73 National Automotive Center of Excellence	2707	2719	2877	2936	2976	3168	3670	3740	Continuing	Continuing

A. Mission Description and Budget Item Justification: The Army's initiative to create three open, federated laboratories is an innovative and forward thinking approach focusing the talents of industry and academia on critical technology needs of the Army. The federated laboratory is a partnership between the Army Research Laboratory (ARL) and the private sector involving cooperative agreements, integrated management and staff rotation, education and communication. The basic construct of a federated laboratory is to continue strong in-house involvement to meet Army-unique requirements where there is little external expertise in the technologies, and to forge direct associations with industry/university consortia with recognized competencies in specific technology areas where the centers of expertise are definitely outside of the Government (i.e. telecommunications). Under the federated laboratory approach, ARL formed partnerships with consortia consisting of at least one each of an industrial company, a major university, and a Historically Black College or University/Minority Institution (HBCU/MI). Long-term cooperative agreements (5 years) were established in three key areas with consortia that have become "virtual labs" within ARL and function as any other ARL division. Research is jointly planned and executed and Army scientists and engineers are intermingled with consortia researchers through long term rotational assignments. The federated laboratory approach for ARL is in accordance

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**

with the 1991 Base Realignment and Closure, and the Department of Defense mandate to exploit private sector research and reduce infrastructure. This program element also

includes the Army's Centers of Excellence, which are the centerpiece of academic linkage to Army R&D organizations. Centers of Excellence continue to be an integral part of the Army's research investment strategy, along with single investigator programs and Army laboratory research. Centers have proven to be highly effective in many applications-oriented projects, in areas such as rotary wing technology and electronics. Centers couple state-of-the-art research programs with broad-based graduate education programs to increase the supply of scientists and engineers in areas of Army importance. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and DoD Project Reliance.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	45138	48459	50799	51769
Appropriated Value	46576	45138		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1438	-299		
b. SBIR / STTR	-1065			
c. Omnibus or Other Above Threshold Reductions	-340			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-3733	-3745
Current Budget Submit (FY 2000 / 2001 PB)	43733	44839	47066	48024

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: BH50

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH50 Telecommunications Research	9656	9073	9668	9821	9978	10459	10947	11483	Continuing	Continuing

Mission Description and Justification: This project establishes long term collaboration between the Army Research Laboratory and competitively selected industry/university consortium headed by Lockheed Sanders, Nashua, NH, for the purpose of leveraging world class research relevant to Army needs. Battlefield telecommunications involve the reliable, timely, and secure electronic transport of multi-media information over heterogeneous, digital networks exhibiting dynamic topologies. The technical areas addressed under this project are: wireless battlefield digital communications; tactical/strategic interoperability; information distribution; multi-media concepts.

FY 1998 Accomplishments:

- 9656 -Developed and demonstrated protocols that support seamless connectivity between satellite and terrestrial segments to optimize communication links between various levels of command.
  -Evaluated the applicability of ATM technology to multi-rate battlefield wireless environments.
  -Developed formal testing and validation methodologies for network simulation models for Army battle commands systems.
  -Developed and demonstrated an executable-code encoded hybrid network simulation to validate commercial specifications in Army communication systems.
  -Developed and demonstrated techniques to support push-pull flow control among information servers based on real-time network events to improve information transfer on the battlefield.
  -Developed and demonstrated scalable multimedia compression techniques which track the rate-distortion curve as the rate is reduced by traffic or bandwidth to enhance wireless battlefield communication.

Total 9656

FY 1999 Planned Program:

- 8832 -Develop and demonstrate alternative signaling protocols for call hand-off, origination, delivery, and internet protocol mobility in a highly mobile battlefield environment.
  -Develop a network management system based on a next-generation, software-based, fault-tolerant distributed object computing platform and a multi-tier network architecture to manage tactical communication networks.
  -Demonstrate tactical data exchange across multiple platforms using adaptive flow control and routing, meta data queries, and user-controllable threshold criteria to enhance seamless information transfer on the battlefield.
  -Demonstrate packetization and error recovery methods for multimedia communications over wireless battlefield channels.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH50**

FY 1999 Planned Program: (continued)

-Demonstrate inter-media and inter-participant multimedia synchronization using sub-millisecond time synchronization to provide multimedia applications to the tactical network.

- 241 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 9073

FY 2000 Planned Program:

- 9668 - Develop data distribution schemes based on adaptive triggers and intelligent agents to support a fault tolerate architecture.
  - Develop a network management system based on a next-generation, software-based, fault-tolerant distributed object computing platform and a multi-tier network architecture to manage tactical communication networks.
  -Demonstrate compression techniques for multimedia delivery to tactical networks.
  -Simulate large-scale highly mobile untethered battlefield networks.
  -Investigate laser communications using adaptive optical techniques.

Total 9668

FY 2001 Planned Program:

- 9821 - Develop information hiding techniques to enhance information assurance over wireless battlefield channels.
  - Simulate large-scale highly mobile untethered battlefield networks.
  - Demonstrate 3D-network management system integrated into advanced visualization techniques for tactical command and control.
  - Demonstrate communications using a laser system with adaptive optics.
  - Investigate mobile wireless communications at frequencies above 5 gigabytes.
  - Investigate global information distribution over satellites or surrogate satellites with intelligent, adaptive multicast techniques.

Total 9821

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: BH53

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH53 Advanced Distributed Interactive Simulation Research	554	1923	1186	1202	1222	2393	2567	2691	Continuing	Continuing

Mission Description and Justification: This project establishes long term collaboration between the Army Research Laboratory and a competitively selected Army Center of Excellence in Information Sciences (ACEIS). The Clark Atlanta University, a HBCU, will perform research in information science. The research focuses on the mid to far-term needs of Army After Next (AAN) Command and Control Systems. It performs research in information science with emphasis in the following areas: interactive and intelligent systems; database and information systems; and distributed and parallel processing systems. Work in this project was previously accomplished in PE 0601102A/BH57. The project also supports the Army High Performance Computer Research Center beginning in FY99. This effort is restructured from project AH48, PE 0601102A.

FY 1998 Accomplishments:

- 554 - Developed a virtual environment testbed to perform research into human computer interaction (3D instead of 2D) in battlefield situations.
  - Applied intelligent data base capabilities to provide advanced solutions to Army logistics problems.
  - Applied parallel processing techniques to tactical command and control.

Total 554

FY 1999 Planned Program:

- 577 - Explore the visual clues that detect a "Sense of Presence" on a virtual battlefield that include the detection, identification, and location of visual stimuli, conveyed to the human via parallel paths.
  - Develop techniques to optimize each stimulus in order to develop effective visualization applications.
  - Explore how battle command knowledge and experience can be utilized to provide visual problem solving for a knowledge base using the internet.
  - Provide an experimental environment to formulate advanced concepts for information transfer systems.
  - Develop a means for identifying signatures of anomalous activities in large data systems.
  - Explore issues associated with transfer of learning in virtual environments.
- 1295 - Extend techniques for simulation of parachute inflation fluid-structure interactions and apply them to parachute fluid structure interactions for full 3D parachute models.
  - Develop methods to model the effect of the vortex-wake system behind a large transport aircraft on paratrooper separation from aircraft.
  - Develop methods to model aircraft wake vortices and vortice shedding as it relates noise generation and suppression from helicopter blades.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH53**

- Develop adaptive girding, mesh moving, and multi-body modeling techniques and apply these techniques to modeling paratrooper exit from large transport aircraft.

FY 1999 Planned Program: (continued)

- Develop mesh-free methods for large deformation analysis of solids and structures; capability to model crack and shear band growth is essential to first principles modeling of the physics of weapons effects.
- Develop, as required for new research applications, fast and efficient parallel mesh generation/regeneration algorithms for use in fluid-object (mesh moving) applications or solution adaptive computations.
- Develop highly parallel solvers for sparse linear systems for applications to solve problems in fluid flow, structural mechanics, electromagnetics and heat transfer.
- Extend virtual environment using neural nets and fuzzy logic. Incorporate advanced data mining techniques into intelligent data base capabilities.
- Investigate technologies for information distribution in a wireless mobile environment.

•	51	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	1923	

FY 2000 Planned Program:

•	732	- Develop parameters to optimize the “Sense of Presence” and performance in battlefield virtual environments. - Explore knowledge acquisition, knowledge dissemination, concept analysis, and decision tools to enable users to engage in visual problem solving technologies when working with large knowledge bases. - Identify signatures of anomalous activities in large data systems using cluster analysis, Fourier Transforms, and Neural Networks. - Study the effects of training transfer from a virtual to a real world environment. .
•	454	- Extend techniques for simulation of parachute inflation fluid-structure interactions and apply them to parachute fluid structure interactions for full 3D parachute models. In conjunction with Natick, verify model against empirical data. - Develop methods to model the effect of the vortex-wake systems behind multiple large transport aircraft flying in formation on paratrooper deployment (i.e., extend model to multiple aircraft and multiple paratroopers).
Total	1186	

FY 2001 Planned Program:

•	758	- Evaluate prototype "Sense of Presence" in a battlefield virtual environment. - Explore techniques to prototype identification of signatures to automatically handle the data analysis in real time on an active system. - Prototype knowledge bank to test concept in virtual problem solving.

•	444	- Deliver production quality software which can be used by Army personnel to the Natick RDEC for simulation of parachute inflation fluid-structure interactions and apply parachute fluid structure interactions for full 3D parachute models. - In conjunction with Natick and other DoD researchers, verify computational models for simulating the vortex-wake systems behind multiple large transport aircraft flying in formation on paratrooper deployment .
Total	1202	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: BH54

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH54 Advanced Sensors Research	9871	9257	9865	10022	10182	10672	11249	11817	Continuing	Continuing

Mission Description and Justification: This project establishes long term collaboration between the Army Research Laboratory and a competitively selected industry/university consortium for the purpose of leveraging world class research relevant to Army needs. Advanced sensors are the elements of systems that view the environment and convert the basic raw sensor data into meaningful information suitable for transmission over tactical networks. The technical areas addressed under this project are: multidomain smart sensors, to include multispectral infrared focal plane arrays; multisensor fusion automatic target recognition algorithms, to include synthesis of sensor modeling; radar sensors, to include atmospheric and terrain effects on propagation; and signal processing, capitalizing on commercially available hardware, microsensors which integrate microelectromechanical systems (MEMS), acoustic seismic, and RF technologies.

FY 1998 Accomplishments:

- 2059 Completed first iteration design/fabrication cycle for the power amplifier/low noise (PALNA) monolithic microwave integrated circuit (MMIC), a key component for future low-cost Electronically-Scanned Arrays. Power densities of 250mW/mm were achieved and transmit/receive (T/R) switching was demonstrated, lending confidence in second pass run next year.
- 2329 Conducted feasibility demonstration of Multi-Domain Smart Sensors (MDSS); obtained pixel registered long wavelength infrared (LWIR) and medium wavelength infrared (MWIR) imagery with boresighted cameras.
- 2046 Demonstrated use of configurable processing for image fusion of two-color LWIR/MWIR imagery and evaluated mapping of multi-scale UWB SAR image formation algorithm to a configurable processor.
- 1230 Developed joint video/inertial testbed and successfully demonstrated joint video/inertial kinematic state estimation.
- 2207 Developed laser radar (ladar) automatic target recognition (ATR) algorithm for use in Target Acquisition ATD.

Total 9871

FY 1999 Planned Program:

- 1804 Develop a comprehensive millimeter wave (MMW) radar backscatter database for low grazing angle backscatter and a scattering model for improved target tracking and detection algorithms.
- 2170 Demonstrate the application of low-power signal processing techniques to a medical monitoring problem and evaluate a network situation of distributed signal processing.
- 1524 Demonstrate imaging with dual color 256x256 quantum well infrared photodetector (QWIP) and 240x320 HgCdTe (MCT) IR Focal Plane Arrays (IRFPAs); obtain 35% quantum efficiency for QWIP detector array.
- 1431 Evaluate distributed microsensor testbed in a MOUT environment.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers PROJECT BH54

FY 1999 Planned Program: (continued)

•	2083	Demonstrate improvement in forward looking infrared (FLIR) ATR performance with update from recent reconnaissance imagery; demonstrate fusion of two sensors for detection of mines and unexploded ordinance.
•	245	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	9257	

FY 2000 Planned Program:

•	2000	Demonstrate a 94GHz radar with a 64-element electronically scanned antenna at an Aberdeen test site. The antenna will capable of receiving a transmitting in two orthogonal polarizations and will employ high level of integration necessary for low cost production.
•	2412	Demonstrate MDSS with dual color IRFPAs and eye safe ladar; demonstrate spatial noise mitigation and low power optical IRFPA read-out techniques.
•	2102	Evaluate computing architectures for the application of adaptive computing techniques to low-power signal processing for networks of distributed microsensors.
•	1178	Evaluate combination of fixed and mobile unattended ground sensors.
•	2173	Multi-fusion algorithms in support of third generation imaging sensors.
Total	9865	

FY 2001 Planned Program:

•	10022	Research innovative adaptive signal processing techniques to enable fusion of self-organizing networks of multidomain. Research adaptive multisensor fusion algorithm that requires minimal training for detection and recognition of battlefield targets. Explore innovative hardware/software architecture for on-sensor processing of advanced multi and hyperspecteral sensors, and multimode RF sensors.
Total	10022	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: BH56

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH56 Advanced Displays Research	4351	4416	5896	5992	6087	6251	6635	6996	Continuing	Continuing

Mission Description and Justification: This project establishes a competitively selected university/industry consortium headed by Rockwell International Corporation, Cedar Rapids, IA, to provide solutions for the many requirements for information assimilation on the battlefield. Displays and control constructs are the interface between human users and computers. This consortium will develop display subsystem architecture which can provide access to all information of practical use, provide data visualization in an efficient manner and use the advanced hardware and software technologies to address the human sensory modality without overloading the user and degrading performance. Work in this project differs from the Defense Advanced Research Projects Agency's (DARPA's) program, which aims to establish a domestic capability for display hardware. The technical areas being addressed under this project are: human-computer interface in an information rich environment; display configuration, real time visualization, architecture, information presentation, and control coupling.

FY 1998 Accomplishments:

- 4351 - Determined physiological indicators of attention.
  - Created database structures allowing for multimedia fusion and the identification and indexing of the data uncertainties in data.
  - Redesigned FOX, a Course of Action (COA) analysis tool, based on user evaluations and identified new ways of problem solving resulting from human-computer interaction (HCI) with FOX.
  - Used SOAR, a micro-model, to develop a working cognitive model for cognitive task analysis of an S-3 (Maneuver).
  - Began integration of CECOM "CADET", Planning and Application tool, with Fed Lab "FOX" Course of Action analysis tool.
  - Initiated testing of a multi-modal (speech, gaze, gesture - I/O) (Common Object Oriented Broker Architecture) CORBA-based, non-platform specific architecture for touchless interaction with a computer.

Total 4351

FY 1999 Planned Program:

- 4299 - Perform scaling studies of spatial reasoning in a large, multi-dimensional battlefield database.
  - Link FOX COA tool to Decision-Analytic Wargaming tool, OWL, to analyze the efficacy of COAs, and demonstrate combined system [linked to CECOM Battlefield Visualization (BV) STO].
  - Integrate and evaluate multi-modal inputs (speech, gaze, gesture and tactile) into battlefield visualization and simulation environments.
  - Display information from widely distributed Microsensor network on commander's workstation.
  - Demonstrate cross-consortium (Displays, Sensors and Telecommunications) research products using the architecture developed in the Integration Support Laboratory (ISL).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers PROJECT BH56

FY 1999 Planned Program: (continued)

- Establish audio icons for joint modality displays.
- Complete integration of FOX & OWL with CADET.
- Plan for and begin implementation of Cognitive Engineering Applications research in the collaborative planning and maneuvering area.

•	117	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	4416	

FY 2000 Planned Program:

•	5896	- Transition refined integrated course of action development and analysis tools for use in collaborative technology STO and ATDs. - Implementation of a registration system and technique for overlaying 3D information onto video or see-through HMD. - Publish guidelines, methods and procedures for development of more effective visual-auditory displays and guidance on use of eyetracking in interacting with displays. - Set of Beta algorithms for vision-based gesture analysis, for speech/gesture integration, and for bimodal speech recognition as well as selected foreign language translation (DRAGON). - Transition Automation Speech Recognition (ASR) server to collaborative technologies STO and ATDs. - Provide initial cognitive Engineering Applications model(s) to collaborative technology STO, CECOM and Battle Labs (support output of Cognitive Engineering STO).
Total	5896	

FY 2001 Planned Program:

•	5992	- Finalize and finish refinement of ISL architecture and transition package to CECOM and Battle Labs. - Develop algorithms using wavelets and fractals for embedded coding of image/video. - Incorporate talking and gesturing avatars into collaborative planning and execution scenarios. - Extend the FOX-RAVEN-CADET paradigm to include collaborative planning within the intelligence arena. - Using Army Soar-MODSAF architecture: provide a commander/staff model capable of conducting cognitive engineering of Army command and control interfaces; create model–opposing force commanders to direct other Soar-controlled unit entities. - Investigate technologies to enable commanders to tailor C2 systems to support their individual cognitive processes. - Research intelligent systems that provide an enabled understanding of information needs for situation and tasks.
Total	5992	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH59**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH59 University Centers of Excellence	3964	4247	6262	6568	7147	5284	5581	5914	Continuing	Continuing

A. Mission Description and Justification Army Centers of Excellence are active in the fields of rotary wing technology, fuel cell technology, the foundations of image science, and science, mathematics, and engineering (SME) training. The Army's Centers have significant collaborative participation by Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) and all future Army Centers will be formed in partnerships with an HBCU. In addition, industry will be encouraged to "buy into" future Army Centers of Excellence to leverage and synergize the investment in these collaborative efforts.

FY 1998 Accomplishments:

•	1612	- Conducted interdisciplinary investigations at Penn State University, the University of Maryland and Georgia Institute of Technology on topics of specific relevance to rotorcraft science and technology base in conjunction with the National Rotorcraft Technology Center.
•	2352	- Synthesized inorganic-polymer nanoscale composites for new cathodes for improved batteries at the Illinois Institute of Technology. - Applied computer aided design to the modeling of forward looking infrared and laser radars at the Washington University to optimize the fusion of sensor information for automatic target recognition. - Increased the number of underrepresented minority students in the fields of science, mathematics and engineering who advanced from Contra Costa College to four year colleges and universities including Brown, UCLA, UC-Berkeley, and Arizona State universities.
Total	3964	

FY 1999 Planned Program:

•	1802	- Conduct interdisciplinary investigations at Penn State University, the University of Maryland and Georgia Institute of Technology on topics of specific relevance to rotorcraft science and technology base in conjunction with the National Rotorcraft Technology Center.
•	2333	- Conclude research at the Illinois Institute of Technology center on advanced fuel cell and advanced battery research and transfer the results to advanced research and advanced technology development. - Develop algorithm independent, fundamental bounds on determining the position and orientation of targets by any sensor at the Johns Hopkins University's Center on image analysis and metrics. - Support science, mathematics and engineering (SME) education at Contra Costa College to strengthen academic programs in SME and attract underrepresented minority students to carriers in these fields.
•	112	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	4247	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH59**

FY 2000 Planned Program:

- 2000 - Conduct interdisciplinary investigations at Penn State University, the University of Maryland and Georgia Institute of Technology on topics of specific relevance to rotorcraft science and technology base in conjunction with the National Rotorcraft Technology Center.
- 2246 - Explore new algorithms and model concepts to develop a set of scientific metrics which quantify image content and complexity for automatic target recognition at the Johns Hopkins University center.
  - Support science, mathematics and engineering (SME) education at Contra Costa College to strengthen academic programs in SME and attract underrepresented minority students to carriers in these fields.
  - Conduct multidisciplinary research in landmine detection and identification which will include efforts involving sensors, sensor and data fusion, discrimination techniques, and response stimulation.
- 2016 - Link entertainment industry and defense through the development of a center to research networked, realistic simulation tools focused on incorporating entertainment industry methods and data into combat training devices.
  - Explore emerging entertainment technologies that may be applicable to meet future Army training needs.
  - Research applicability of entertainment database tools and methods for use in Army modeling and simulation.

Total 6262

FY 2001 Planned Program:

- 2000 - Conduct interdisciplinary investigations at Penn State University, the University of Maryland and Georgia Institute of Technology on topics of specific relevance to rotorcraft science and technology base in conjunction with the National Rotorcraft Technology Center.
- 2270 - Develop computer models of targets and synthetic image generation to guide theoretical work and verify existing image recognition theories at the Johns Hopkins University center.
  - Support science, mathematics and engineering (SME) education at Contra Costa College to strengthen academic programs in SME and attract underrepresented minority students to carriers in these fields.
  - Conduct multidisciplinary research in landmine detection and identification which will include efforts involving sensors, sensor and data fusion, discrimination techniques, and response stimulation.
- 2298 - Support research center on networked, realistic simulation tools focused on incorporating entertainment industry methods and data into combat training devices.
  - Explore emerging entertainment technologies that may be applicable to meet future Army training needs.
  - Research applicability of entertainment database tools and methods for use in Army modeling and simulation.

Total 6568

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: BH62

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH62 Electromechanics and Hypervelocity Physics	9041	8669	6905	7006	7128	6404	5701	6102	Continuing	Continuing

Mission Description and Justification: Electromechanics and hypervelocity physics support critical Army research relating to electromechanical components (electromagnetic launchers and power supplies) for applications to electromagnetic (EM) and electrothermal-chemical (ETC) 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 Electric Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power 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 potential applications for anti-armor, artillery and air defense.

FY 1998 Accomplishments:

- 9041 - Demonstrated gouge resistant rail configuration.
  - Designed and tested low parasitic mass launch packages.
  - Conducted laboratory experiments on hypervelocity novel penetrators versus advanced armors.
  - Demonstrated hypervelocity novel penetrator capable of meeting exit criteria.
  - Provided electrophysical education support to the Army.
  - Performed critical studies to support electromagnetic (EM) and electrothermal-chemical (ETC) pulsed power needs.

Total 9041

FY 1999 Planned Program:

- 8439 - Demonstrate efficient hypervelocity gun launch of lethal launch packages with sufficient gun rail life and projectile accuracy to compete with conventional gun technology.
  - Show superior defeat of advanced armors with hypervelocity penetrators.
  - Establish the system utility of the EM gun concept.
  - Support the compulsator exploitation efforts and explore alternative technologies.
- 230 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 8669

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH62**

FY 2000 Planned Program:

•	6905	- Prove the robust defeat capabilities of hypervelocity penetrators.
		- Examine launcher and launch package technologies for future field applications.
		- Examine integration of EM and ETC into future fighting vehicles.
		- Support alternative EM pulsed power applications.
		- Begin study of advanced ETC pulsed power.
		- Provide high current, fast transient switching for EM pulsed power.
		- Examine electric power generation, storage and distribution for mobility.
Total	6905	

FY 2001 Planned Program:

•	7006	- Exploit robust novel hypervelocity penetrator.
		- Test material and structural components of launchers and launch packages for future field applications.
		- Test alternate EM pulsed power options.
		- Fabricate advanced ETC pulsed power.
		- Provide advanced switch technology for mobility.
		- Evolve thermal management technology for EM pulsed power, switching, and railgun needs.
Total	7006	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: BH64

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH64 Materials Center of Excellence	1736	2221	2434	2472	2511	2560	2761	2925	Continuing	Continuing

Mission Description and Justification: This project promotes long-term collaboration between the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD and University/Industry Research Centers for the purpose of conducting world class research and exploiting fundamental breakthroughs in materials science relevant to Army needs. Basic research in materials science and engineering is focused on the Army's armor, armament, soldier protective mission, and related Defense Science Research Objectives. The project currently emphasizes advanced materials characterization, composite materials and dendritic polymers research for lightweight, structural armor and armaments; integrated and multifunctional composites; chemical biological barrier materials and other critical applications. Current collaborative research agreements are with the University of Delaware, Johns Hopkins University, Baltimore, MD, and Michigan Molecular Institute. This work is closely coordinated with the ARL in-house materials research project funded through PE 0601102A, Project AH42.

FY 1998 Accomplishments:

- 1736 - Characterized graded metal matrix composites using near-field ultrasonic probe technology.
  - Fabricated, characterized, and modeled multi-layer Nb/Si, Ni/Si, and $Cu0_2$ foils designed for self-propagating, exothermic reaction joining of metals and ceramics.
  - Characterized the role of inclusions on hydrogen transport in multi-layer metallic films.
  - Established a process for multi-resin co-injection of integral composite armor material.
  - Measured and analyzed dispersion and dissipation phenomena of shock wave propagation in woven fabric composites.
  - Synthesized and characterized the structure of novel hyperbranched and dendrigraft polymers and encapsulated inorganic nanocomposites.

Total 1736

FY 1999 Planned Program:

- 2162 - Characterize SiC surfaces and thermal cycling effects on electrical, structural and metallurgical properties of SiC contacts and interfaces.
  - Model and demonstrate novel, low-cost co-injection processing of stitched, integral composite armor materials.
  - Develop micromechanical models that incorporate polymer-fiber interphase phenomena and accurately predict processing and moisture effects on residual stress and other critical composite material properties.
  - Develop new model and improved Ion Beam Assisted Deposition processing technology that involves photon stimulated dissociation of absorbed hydrogen to explain and control the formation of diamond-like coatings on surfaces of advanced materials.
  - Develop novel dendritic and hyperbranched polymer-fiber surface treatments and significantly enhance the environmental durability and shear/impact resistance of composite materials.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers PROJECT BH64

FY 1999 Planned Program: (continued)

- Design and demonstrate dendritic polymer substrate and bioconjugate materials for use in biotoxin detection and immobilization.

•	59	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	2221	

FY 2000 Planned Program:

•	2434	- Design and evaluate computational models to represent progressive damage in fiber-reinforced, polymer composites under shock loading. - Develop and demonstrate novel experimental techniques to measure nanoscopic mechanical properties and understand high-strain rate behavior in sub-micron region next to fiber surfaces and at the interface between dissimilar materials. - Develop and demonstrate in-situ ultrasonic velocity technique for process monitoring of transparent armor ceramic (ALON) transient liquid phase sintering. - Develop and implement procedures for low-cost, large-scale synthesis of novel thermally stable and adaptable, hyperbranched dendrimers for possible use in protective clothing, membranes and coatings. - Design and synthesize adaptable, hyperbranched dendrimers. - Develop nanocomposite materials for environmentally friendly, chemical/ biological agent decontamination.
Total	2434	

FY 2001 Planned Program:

•	2472	- Extend basic theory, processing technology, and testing methodology for tailoring and characterizing fiber surfaces, fiber-matrix interphase, matrix composition, and 3-D architecture of fiber-reinforced composite materials. - Establish guiding principles for data documentation, testing and design of multi-functional, integrated composite materials. - Develop transport models and extend basic knowledge to describe and understand penetrant-penetrant and penetrant-polymer interactions in multiphase polymer systems and for selective/controlled transport of penetrants in tailored "smart" polymer membranes and coatings. - Establish underpinning theory and processing technology for rapid repair and joining of dissimilar metals/ceramics by self-propagating reactions in multi-layer foils.
Total	2472	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH65**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH65 Microelectronics Center of Excellence	1853	2314	1973	2005	2037	2667	2858	3021	Continuing	Continuing

Mission Description and Justification: The Microelectronics Research Collaborative Program (MCRP) will establish a long term collaboration between ARL Physical Sciences Directorate and universities to ensure a seamless, synergistic cooperative work environment to provide the Army the key technologies and analytical support necessary to assure supremacy in future land warfare. The goals of this effort are to conduct innovative research and exploit new concepts in solid-state physics, electronics engineering and chemical/electrochemical engineering, and provide mutual exchange of public and private sector researchers working at each other's institutions. The technical areas being addressed under this project are: nanoelectronics/optoelectronics; electrochemistry/energy science; biological/chemical detection; high frequency and quasi-optical electronics; piezoelectronics; microelectromechanics.

FY 1998 Accomplishments:

- 1853 - Threshold current in vertical cavity surface emitting lasers (VCSECs) reduced to below 1 milliamp using oxidation fabrication techniques.
  - Incorporated lanthanum strontium cobalt oxide (LSCO) conducting perovskite oxide into an uncooled infrared (IR) sensor structure.
  - Tapered optical fiber flucrosensor with one square foot footprint developed for the detection of chemical and biological agents. Sensitivity measured as low as 25 pico-roles per milliliter when detecting helicobacter pylori.

Total 1853

FY 1999 Planned Program:

- 2253 - Perform research in ultra-small/nano-scale electronic/photonic device structures addressing modeling, materials, nanofabrication, characterization, and measurement of performance for high-speed signal processing.
  - Investigate heterostructures, materials, optical sources, detectors, waveguides, phase shifters, and optoelectronic integrated circuits for optical signal processing and optoelectronic component technology.
  - Study device physics of optoelectronic (OE) devices as well as design, fabrication, radio frequency (RF)/optics integration and optical interconnects. Investigate the device physics, fabrication methods, and characterization of electronic and OE devices operating in the millimeter-wave, terahertz, and light-wave domains for radar, communications-on-the-move, and target acquisition.
  - Explore new materials, components and fabrication techniques to improve performance, increase safety, and reduce life-cycle costs of high density primary and rechargeable batteries and fuel cells for man-portable applications.
  - Conduct fundamental research into new classes of chemical/biological microminiature sensors interfaced with micro-optoelectronic circuitry, multi-toxin sensor arrays, and ultra-sensitive detection materials for miniature, low-cost detectors.
- 61 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2314

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH65**

FY 2000 Planned Program:

•	1973	- Research novel electronic and optoelectronic materials and devices for multifunctional, miniature sensors. - Investigate the potential for new sensors and sensor processing based on the development of new electronic and optoelectronic devices.
Total	1973	

FY 2001 Planned Program:

•	2005	- Research novel electronic and optoelectronic materials and devices for multifunctional, miniature sensors - Investigate the potential for new sensors and sensor processing based on the development of new electronic and optoelectronic devices.
Total	2005	

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

DATE: February 1999

BUDGET ACTIVITY: 1 - Basic Research

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

PROJECT: BH73

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH73 National Automotive Center of Excellence	2707	2719	2877	2936	2976	3168	3670	3740	Continuing	Continuing

Mission Description and Justification: The Center of Excellence for Automotive Research, established in 1994, is a key element of the basic research module of the National Automotive Center (NAC), located at the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC). The Center of Excellence for Automotive Research is an innovative university/industry/government consortium leveraging commercial dual use technology for the Army through on-going and new programs in automotive research, allowing significant cost savings while maximizing technological productivity. The selected university partners include: University of Michigan, University of Iowa, 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.

FY 1998 Accomplishments:

- 2707 - Completed initial overall vehicle simulation model.
  - Completed dual-need virtual prototyping infrastructure.
  - Extended experimental validation of models using state-of-the-art transient prototypes.

Total 2707

FY 1999 Planned Program:

- 2650 - Complete optimization of dual-need overall simulation network.
  - Complete experimental validation of fully functional system model using advanced hardware prototypes.
  - Finalize detailed mechanism of effective government, industry and academia partnering and provide recommendations for future relevant tasks.
- 69 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2719

FY 2000 Planned Program:

- 2877 - Initiate derivation of next generation of high fidelity military vehicle simulation models.
  - Assess accuracy of new simulation capability using enhanced, unique experimental procedures.

Total 2877

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **1 - Basic Research**	PE NUMBER AND TITLE **0601104A University and Industry Research Centers**
	PROJECT **BH73**

FY 2001 Planned Program:

•	2936	- Incorporate new generation building blocks for enhanced military vehicle simulation models. - Assess new simulation model accuracy over a wide range of military vehicles and conditions.
Total	2936	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602105A Materials Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	12319	13012	13849	13825	15549	16404	15084	15828	Continuing	Continuing
AHM1 Hardened Materials	2811	2980	0	0	0	0	0	0	0	5791
AH84 Materials	9508	10032	13849	13825	15549	16404	15084	15828	Continuing	Continuing

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. Project AH84 is directed toward developing materials technology that will make our heavy forces lighter and more deployable, and our light forces more lethal and survivable. Project HM1 focuses on developing the materials technology needed so that future strategic missile interceptors can meet stringent performance demands. Work in this program element has been coordinated with the other military services through the Materials/Processes Area Plan to prevent duplication of effort and to maximize the return on investment. . Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	12415	10137	11344	12513
Appropriated Value	12811	13137		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-396	-125		
b. SBIR / STTR	-72			
c. Omnibus or Other Above Threshold Reductions	-24			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+2505	+1312
Current Budget Submit (FY 2000 / 2001 PB)	12319	13012	13849	13825

Change Summary Explanation: Funding – FY 1999 – Congressional add for Hardened Materials (+3000).
FY 2000 (+2271) and FY 2001 (+1348) to support research on compulsator materials and light weight vehicle armor materials.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602105A Materials Technology

PROJECT: AHM1

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AHM1 Hardened Materials	2811	2980	0	0	0	0	0	0	0	5791

Mission Description and Justification: This is a Congressionally Funded program; not part of the Army's core mission funded program. This project focused on developing the materials technology for critical components meeting the stringent requirements of strategic interceptors. Materials development for the advanced composite shroud (ACS) enables expansion of the battle space for strategic interceptors by allowing systems to be flown at conditions 3 times more stringent than the current state of the art. This technology program was managed by the Army Research Laboratory, Aberdeen Proving Ground, MD, with contractual efforts at Fiber Materials, Incorporated, of Biddeford, ME (prime), and included as subcontractors Crystal Systems, Inc., of Salem, MD, and Lockheed/Martin Corp., of Sunnyvale, CA.

FY 1998 Accomplishments:

- 2811 - Developed and prepared the advanced composite shroud for full-scale sled test at Holloman Air Force Base to verify the separation dynamics at flight conditions.

Total 2811

FY 1999 Planned Program:

- 2902 - Conduct two flight tests of the ARL composite shroud, for Advanced Interceptor Technology (AIT) configuration
  - Characterize failure modes for single crystal sapphire
  - Conduct initial characterization studies of single resin system for shroud/heat shield
- 78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2980

FY 2000 Planned Program: Project not funded in 2000

FY 2001 Planned Program: Project not funded in 2001

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602105A Materials Technology

PROJECT: AH84

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH84 Materials	9508	10032	13849	13825	15549	16404	15084	15828	Continuing	Continuing

Mission Description and Justification: This project provides the technical foundation for materials technology in metals, ceramics, polymers, and composites essential for their optimum application to future Army systems. It also provides the technology base required for solving materials-related problems in individual soldier support equipment, armor, armaments, aircraft, ground and combat vehicles and combat support. 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. Areas of study in these developments are in characterization, to include high strain rate characterization, processing, and fabrication of these materials. Additional efforts provide materials solutions for improved performance, durability, and cost reduction in Army unique systems. The work is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD and Hampton, VA and provides required technologies for advanced development programs at the Armaments Research, Development and Engineering Center, Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center, Warren, MI; the Aviation Research, Development and Engineering Center, Huntsville, AL; the Natick Research, Development and Engineering Center, Natick, MA; and the Missile Research, Development and Engineering Center, Huntsville, AL.

FY 1998 Accomplishments:

- 2670 - Provided component ferroelectric material for full scale phase shift antenna. Licensed ferroelectric formulation patents.
  - Developed refractory metal based warhead liner materials using novel processing techniques.
  - Applied novel, inexpensive processes to produce refractory metal coatings to increase the performance of large caliber direct and indirect fire platforms.
- 6230 - Produced transparent armor material in a prototype configuration for individual soldier protection.
  - Provided modeling and simulation codes as guidelines to improving the ballistic resistance of ultra lightweight armor material.
  - Evaluated novel processing methods for improved chemical resistance of polymers/elastomers for chemical/biological agent protection of Army and materiel systems.
  - Developed integral composite structures that combine structural capabilities and ballistic performance without collateral damage.
  - Developed novel armor plate and ballistically tolerant metallic materials using laser processing.
  - Enhanced laser ultrasonic inspection technology to detect and characterize flaws in ground and air vehicles; flight tested the mission intensity counter to improve the intensity versus component damage rate model; and advanced active suspension control technology by incorporating brake induced vibration data.
- 608 - Developed microwave Non-Destructive Evaluation methods for multi-layered armor/composite structures; applied laser ultrasonic inspection system to flaw detection and characterization; validated a smart structures model for elastic coefficients; flight tested the Mission Intensity Counter; developed a non-linear structural dynamic model of NASA Langley's advanced piezoelectric 'smart' material (Thunder); and investigated brake induced vibration effects on active suspension control.

Total 9508

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602105A Materials Technology
PROJECT AH84	

FY 1999 Planned Program:

•	6562	- Determine enhanced ballistic performance and dynamic response of ultra-lightweight armor materials. - Demonstrate advanced polymeric/barrier materials that offer improved performance and durability in Army chemical defense applications. - Elucidate processing/microstructure/property relationships of nanostructured polymers and nano-reinforced ceramic materials for improved survivability in Army systems. - Develop computer models that determine the structural as well as ballistic performance of complex composite material systems for application to the family of future lightweight combat vehicles. - Optimize process for fabricating ballistically resistant hybrid laminate. - Develop rapid prototyping of ballistically tolerant novel components via laser processing. - Quantify ballistic enhancement in integral ceramic/composite armor. - Characterize and elucidate processing and microstructural relationships to produce novel metallics, ceramics and intermetallic microstructures for engineering lightweight structural armor materials
•	2813	- Characterize, in simulated gun firings, the enhanced erosion resistance of advanced coating systems designed to significantly increase gun barrel lifetime. - Demonstrate improved ferroelectric ceramic processing using double doping to deduce losses and increase tunability for significantly reducing the cost and weight of future antenna systems. - Fabricate prototype refractory metal shaped charged liners and examine their processibility. - Develop processing techniques for fabrication of nano-materials to replace depleted uranium in penetrators.
•	642	- Investigate fatigue, flaw detection, and material characterization of thick composite structures; and correlate analytical model of smart material 'Thunder' with dynamic test results. - Develop advanced non-destructive evaluation (NDE) methodology for improved structural analysis and flaw/damage detection in composites; incorporate dynamic data into smart materials model; test active suspension system control for ground vehicles.
•	15	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	10032	

FY 2000 Planned Program:

•	3190	- Develop atomic scale, physical-based models of propellant gas interactions with the gun bore surface to predict the durability of the bore surface for a variety of coatings systems and propellants. - Demonstrate dielectric materials for miniature smart munition antenna sections to enable extended range and improved accuracy for both direct and indirect fire weaponry. - Fabricate prototype refractory metal explosively formed projectile liners and determine their processibility.
•	7310	- Develop life prediction models for Army materiel based on accelerated weathering, cyclic corrosion testing, and real-world exposure studies that will significantly reduce logistical costs for Army systems.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602105A Materials Technology
PROJECT AH84	

FY 2000 Planned Program: (continued)

- Quantify and optimize sensor arrays to assess ballistic damage, environmental degradation and potential chemical/biological agent threats.
- Fabricate and evaluate new mass-efficient means to improve the ballistic resistance of ceramics by integrating them with organic-matrix composites to enable improved lightweight combat vehicles.
- Determine the microstructural influences of metallic-intermetallic-ceramic components on the performance of current composite armor designs

•	739	- Conduct microwave NDE measurement and analyses for large composite structures; develop more portable and field usable laser ultrasonic inspection technique; demonstrate a portable, integrated 3D imaging technique for improved inspection of complex structures; and evaluate 'MONGREL', an advanced off-road, high-speed wheeled testbed, for structural dynamics research.
•	1185	- Determine critical materials technologies essential for the successful demonstration of pulsed power machines for AAN.
•	1425	- Determine high strain-rate behavior and failure criteria of layered and functionally graded ceramics, metals and anisotropic composites to develop constitutive models to abet the rational design of materials for high-performance, integrated, multifunctional armors
Total	13849	

FY 2001 Planned Program:

•	8197	- Demonstrate reduced-cost, appropriate-quality processing technology for lightweight combat vehicles that feature the integrated armor structure technologies available. - Develop procedures for producing bulk materials with nano-scaled microstructures for protection from extreme environments. - Model and engineer candidate multi-phase functionally graded microstructure for penetration resistance and minimal collateral damage in future lightweight combat vehicles. - Integrate multifunctional sensor arrays to assess ballistic damage, environmental degradation and potential chemical/biological agent threats.
•	3484	- Produce a full scale section of a large caliber gun tube coated with an enhanced erosion resistant refractory metal coating applied by high velocity spray techniques. - Demonstrate thin film phase shifter materials with properties comparable to bulk materials for significantly reducing the cost and weight of future antenna systems. - Characterize relevant material properties of previously developed refractory metal warhead liners and optimize processing parameters for greater reliability and performance.
•	796	- Evaluate prototype microwave NDE hardware using TACOM-provided composite test components; complete laser ultrasonic inspection technology development and checkout; and investigate control algorithms for the "MONGREL" active suspension.
•	1348	- Validate penetration and structural simulations to enable material design for future multifunctional, high-performance armor/structure solutions to counter medium-caliber and residual (post APS) large-caliber threats to AAN combat vehicles."
Total	13825	

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	25545	16614	22978	23723	23053	23248	24287	25736	Continuing	Continuing
AH15 Ground Combat Identification Technology	3268	3546	3354	3494	3578	3674	3920	4113	Continuing	Continuing
AH16 S3I Technology	14962	10242	16608	17018	16181	16165	16798	17847	Continuing	Continuing
A140 High Power Microwave (HPM) Technology	2632	2826	3016	3211	3294	3409	3569	3776	Continuing	Continuing
A142 Passive Millimeter Wave (MMW) Camera	4683	0	0	0	0	0	0	0	0	4683

A. Mission Description and Budget Item Justification: The objectives of this program are: (1) to provide 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 (2) to determine and reduce the susceptibility and vulnerability of Army equipment and systems to nuclear and radio frequency (RF)/high power microwave (HPM) environments. Three critical technologies are addressed to increase the combat effectiveness of tactical Army forces: (1) high power microwave (HPM) technology; (2) combat identification technology; (3) sensors, signatures, signal and information processing (S3I) technology. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Force Modernization Plan and Project Reliance.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	25855	18738	19532	20996
Appropriated Value	26794	16895		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-939	-281		
b. SBIR / STTR	-233			
c. Omnibus or Other Above Threshold Reductions	-77			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+3446	+2727
Current Budget Submit (FY 2000 / 2001 PB)	25545	16614	22978	23723

Change Summary Explanation: Funding – FY 1999 – Congressional reduction to President's Budget request (-1843).
FY 2000 (+3446) and FY 2001 (+2727) increase to transition products from the Advanced Sensors Fed Lab and transfer of NATO R&D funding.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability

PROJECT: AH15

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH15 Ground Combat Identification Technology	3268	3546	3354	3494	3578	3674	3920	4113	Continuing	Continuing

Mission Description and Justification: This program provides the enabling technology necessary to demonstrate advanced Combat Identification (CI) concepts and systems for mission areas not considered to date. The hardware and software improvements and modeling and simulation advances provided by this project are essential to expand and build upon the midterm CI architecture. The operational impacts to be realized are reduced fratricide and a significant increase in combat effectiveness. CI is also strongly related to the Army's larger objective of Battlefield Digitization and synergistically supplements that effort by addressing the fusion of situational awareness (SA) and point-of-engagement target identification (TI).

FY 1998 Accomplishments:

- 3268 - Completed integration of combat identification for the dismounted soldier (CIDDS) function into Land Warrior (LW) equipment suite.
  - Analyzed and developed target identification (ID) concepts for the dismounted soldier, to include soldier-to-vehicle and vehicle-to-soldier.
  - Completed architecture study using constructive simulation to assess operational effectiveness of different CI architectures and cost information to define performance vs. cost trade-offs.

Total 3268

FY 1999 Planned Program:

- 3457 - Demonstrate integration of CIDDS functionality during the Force XXI LW Integrated Technology Demonstration.
  - Complete prototyping and integration of the vehicle to dismounted soldier CI system.
  - Demonstrate integration of ID data from situation awareness (SA) and Target ID sources through the sight display in a virtual experiment.
  - Determine optimum CI technical approach for Fire Support Teams and Apache Longbow.
- 89 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3546

FY 2000 Planned Program:

- 3354 - Demonstrate integration of CIDDS functionality with BCIS to provide vehicle-to-soldier ID capabilities.
  - Conduct evaluations of selected CI solutions for Apache Longbow.
  - Demonstrate an automated single channel ground and airborne radio system (SINCGARS) based ID capability for Fire Support Teams (FiST).
  - Develop algorithms for fusion of point-of-engagement target ID data with SA.

Total 3354

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability
	PROJECT AH15

FY 2001 Planned Program:

•	3494	- Demonstrate an integrated target ID and SA capability for vehicle ID. - Demonstrate a proof of concept of ID capabilities for Apache Longbow. - Evaluate the different CI architectures as a function of performance (operational), cost, maturity and interoperability.
Total	3494	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability
	PROJECT AH16

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH16 S3I Technology	14962	10242	16608	17018	16181	16165	16798	17847	Continuing	Continuing

Mission Description and Justification: This project provides for the synergistic development of sensors; signal processors; sensor and information processing; and automatic target recognition (ATR) technology for RSTA, fire control, smart munitions and fuzing systems. In the RISTA and fire control area, the project will develop and demonstrate: (1) advanced ultra wide band (UWB) radar technology for adverse weather, wide-area detection, location and recognition of tactical ground targets concealed in foliage, and buried mines; (2) innovative algorithms for the detection, discrimination, and classification of stationary targets from a low flying helicopter; (3) ATR algorithms that synergistically use outputs of forward looking infrared (FLIR), millimeter wave (MMW) radar and laser radar (LADAR) sensors to identify combat vehicles and perform signature predictions in many bands (infrared, visible, MMW, and LADAR) from targets and backgrounds at specified times, weather conditions and locations; (4) affordable, lightweight target acquisition radar technology for man-portable and battlefield platform applications; (5) advanced optical processing techniques to automatically process, at the sensor, the received signals into target information of sufficiently narrow bandwidth to be compatible with Army communications systems; (6) advanced battlefield sensor and information processing to conduct a dynamic and real time situation assessment to present a common picture of the battlespace to commanders; and (7) advanced information processing methods to provide automatic information systems support to enable commanders to utilize widely dispersed sensor and legacy information sources. Project goals in the smart munitions and fuzing area include development of advanced microwave, millimeter wave (MMW), acoustic, electrostatic, and LADAR technologies to reliably sense low cross section targets in high countermeasures and clutter environments. These technologies support the Force XXI modernization efforts, the Army battlefield digitization effort, Advanced Technology Demonstrations/ Advanced Concept Technology Demonstrations (ATD/ACTD) such as: Intelligent Minefield; Target Acquisition; Remote Sentry; Rapid Force Projection Initiatives; Battlespace Command and Control; Joint Combat Identification; and rapid Battlefield Visualization; and systems such as: Longbow, advanced submunitions, standoff fuzing for anti-armor munitions, proximity fuzing, range finding for bursting munitions, smart mines, multi-option fuze for artillery; guided and unguided tank, mortar and artillery ammunition, and anti-aircraft applications including projectile and missile fuzing..

FY 1998 Accomplishments:

- 2344 - Designed, simulated, fabricated and evaluated optical interconnect circuitry consisting of oxidized 8x8 Vertical Cavity Surface Emitting Laser (VCSEL) array flip-chip bonded to Complementary Metal Oxide Semiconductor (CMOS) drive circuits.
  - Designed, fabricated and tested imaging Acoustic-Optical Tunable Filter (AOTF) in the visible. Designed imaging AOTF for the infrared.
- 4137 - Demonstrated target acquisition and tracking of ground vehicles using testbed.
  - Reported on capability to perform Ultra Wide Band (UWB) Synthetic Aperture Radar (SAR) processing steps in real-time on an airborne platform.
  - Demonstrated stationary target discrimination techniques for real beam radars that increase probability of detection in diverse environments.
- 7001 - Developed acoustic sensors to passively detect, locate, track, and identify ground vehicles, aircraft, artillery and mortar fire, and other battlefield targets.
  - Developed new algorithms for the detection of infrasonic signals generated by cruise missile signatures, missile launches, artillery fire, etc.

- Researched, built/modeled prototype, evaluated and integrated ultrasonic sensors for Parachute Soft Lander.
- Developed acoustic sensors to monitor soldier physiological signs.

FY 1998 Accomplishments: (continued)

- Demonstrated effective detection of extremely low frequency (ELF) signature on helicopters in clutter environments.
-Developed an improved 8-12 micron target recognizer using compact target signature representations

- 1480 - Developed a set of algorithms, methods, and Application Programmers Interface based software subsystems, and modules to enhance the access and display of battlefield sensor information in an integrated 2D / 3D environment.
- Demonstrated concepts for improved processing and algorithms for the real-time transformation of sensor and environmental information, such as integrated weather and chem / bio agents with terrain data into a unified battlefield visualization environment
- Developed a multi-modality human / computer module which will enable the user to interact with multiple displays and/or display modalities through a more multi-modal interface which includes gesture, eye tracking and natural language. The results of this research are being leveraged by Defense Information Systems Agency (DISA) to help stage the Defense Information Infrastructure/Common Operator Environment (DII / COE) standards for 3D visualization of sensor and other C2 data.
Prototype 2D / 3D visualization environment is a strong candidate for transition to the OSD Demo 3 Robotics Program as the display for platform status and sensor information.

Total 14962

FY 1999 Planned Program:

- 3286 -Integrate second-generation stationary target information algorithms into wideband testbed.
-Report on performance of UWB SAR algorithms to provide reliable discrimination of mines in clutter.
-Improve stationary target classification for real beam radars by using adaptively weighted mean square error metrics and efficient multi-resolution template pruning strategies.
- 2850 -Demonstrate optoelectronic processor interconnect circuit involving advanced CMOS drive circuits capable of some processing functions and VCSEL array interconnects.
-Design, fabricate and evaluate infrared (IR) imaging AOTF.
-Develop novel emissive display structures
-Characterize optical limiters
-Optical/Digital Imaging and diffractive optical elements (DOE) development
- 4106 -Develop acoustic detection algorithm for multiple target identification. Develop body-worn sensor for soldier performance monitoring; develop capability for medic to interrogate soldiers remotely; evaluation of mortar munition test firings to demonstrate capability to glide extended ranges in excess of 12km with a 120mm mortar munition; evaluate potential impact of magnetic sensors for unattended ground sensors;
-Develop concepts and tools for sensor fusion on unattended ground sensors.
-Train an ATR algorithm originally developed using 8-12 micron thermal emission phenomenology with 3-5 micron data and assess performance.

Total 10242

FY 2000 Planned Program:

- 4305 -Evaluate field techniques for calibration of coherent fully polarimetric active and passive MMW target acquisition systems.
  -Evaluate performance of second-generation mine detection algorithms and performance of forward-looking vehicle mounted sensors.
  -Investigate impact of near and far field signatures on MMW target acquisition emulations and algorithm development.
- 2100 - Demonstrate visible imaging microsensor and IR imaging microsensor designs.
  -Evaluate magnetic sensor capabilities for unattended ground sensors
- 4281 -Develop advanced acoustic target identification algorithms
  -Demonstrate multi-target acoustic tracking
  -Develop a fused 3-5 micron and 8-12 micron ATR algorithm exploiting unique characteristics of each and assess performance
- 3183 -Perform remote sensing and hyperspectral imaging experiments with IR AOTF's.
  -Develop algorithm and processing architecture for hyperspectral imaging.
  -Demonstrate beam steering with micro-scale diffractive optical elements.
  -Demonstrate breadboard optical limiters.
- 2039 - Demonstrate and validate an integrated set of reasoning, visualization, data access and touchless computer interface algorithms for transition to CECOM's Cyber Command Post Program.
  - Investigate techniques for the auto-rectification of submeter resolution sensor data for viewing in an integrated 2D / 3D environment.
  - Integrate (from AH48) intelligent system technology that compares, in the background, sensed information against user specified priority information requests and focuses user attention to the sensed information.
  - Integrate untethered gesture recognition research (from Displays Fed Lab) into touchless computer interface modules.
- 700 - Next- Generation Autonomous Vehicle Navigation Control System (AUTOVAV) (Partner: Germany): Continue design and development of an advanced autonomous vehicle navigation control system. Complete sub-system tests of obstacle detection, classification, and avoidance technologies.

Total 16608

FY 2001 Planned Program:

- 4645 -Validate second generation mine detection algorithms with plastic mines in new environments.
  -Extend functionality of MMW radar emulation to smart weapons like millimeter wave (MMW) Longbow Hellfire and Tank Extended Range Munitions (TERM).
  -Apply calibration and image formation techniques to field tests to support development of Ka-Band vehicle mounted multifunction RF sensor.
- 3274 -Demonstrate electro-optical processor capability for image processing
  -Investigate flexible displays

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability / PROJECT: AH16

- 1300 -Demonstrate integrated acoustic/seismic/imaging microsensor network.
  -Develop sensor fusion concepts for acoustic/seismic/magnetic sensor
  -Demonstrate magnetic sensor capabilities in Warrior Extended Battlespace Sensors (WEBS) testbed

FY 2001 Planned Program: (continued)

- 4871 -Demonstrate advanced acoustic target identification algorithms with real targets
  -Develop first iteration of a multi-band spectral imager-based ATR algorithm compatible with land warfare scenarios
- 2328 - Demonstrate intelligent agents for mission planning, rehearsal and status monitoring of physical RSTA agents and visualize the process in an integrated 2D/3D display environment.
  - Demonstrate and validate final integrated set of reasoning, visualization, data access and touchless computer interface algorithms into CECOM Cyber Command Post Program.
- 600 - Next- Generation Autonomous Vehicle Navigation Control System (AUTOVAV) (Partner: Germany): Continue design and development of an advanced autonomous vehicle navigation control system. Complete sub-system tests of obstacle detection, classification, and avoidance technologies.

Total 17018

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability

PROJECT: A140

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A140 High Power Microwave (HPM) Technology	2632	2826	3016	3211	3294	3409	3569	3776	Continuing	Continuing

Mission Description and Justification: The objective of this project is to develop the tools, techniques and methodology to assess the susceptibility and vulnerability of Army equipment and systems to various types of radio frequency (RF)/high power microwave (HPM) environments, and to identify, develop, and evaluate the technologies required to protect and harden US equipment as well as to enable weaponization. This program is coordinated and, when appropriates, leveraged with HPM programs in the Air Force, Navy, Defense Special Weapons Agency, National Labs, University Consortia and relevant industry and foreign partners.

FY 1998 Accomplishments:

- 2632 -Determined RF susceptibility levels for selected air targets and conducted a feasibility study for counter-air directed energy capability in support of US Army Air Defense Artillery School (USADASC).
  -Conducted RF effects investigation of threat artillery/mortar fuzes for potential improvements to SHORTSTOP in support of CECOM.
  -Conducted studies, experiments and design efforts on standard shelters in support of NATICK RF mitigation efforts and future digital force survivability.
  -Completed the design of an L-band slotted waveguide antenna for Army vehicles and RF field tests, and developed an RF propagation formulation for the prediction of high frequency field levels over earth or sea.
  -Demonstrated effects of commercial off-the-shelf (COTS) RF threats on commercial electronics for the Joint Program Office on Special Technology Counter Measures.
  -Provided expertise to Army RDECs, PMs, Inspector General, and the National Intelligence Council regarding DE threat environments, effects, and hardening technology insertion.
  -Completed preliminary design for improved high average power Reltron HPM source buncher cavities. Designed Reltron test bed and beam stick.
  -Completed design of buncher cavity, preliminary design of beam stick, modulator and diagnostics for high average power broadband klystron amplifier. Deliverables included technical papers and presentations.
  -Designed high average power tube development test bed (construction dependent on other funding).
  -Formulated experimental, numeric and analytic models and techniques that will permit high confidence cost-effective assessments and evaluations of stand-alone and networked equipment exposed to RF/HPM threats. Efforts concentrated on the evaluation of RF propagation and the effects of building structures in enhancing RF susceptibilities of contained equipment (an observed but ill understood problem).
  -Formulated and modeled the data and information flow, into, out of, and within the Abrams M1A2 and Longbow Apache AH64-D.

Total 2632

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability — PROJECT: A140

FY 1999 Planned Program:

•	2790	-Determine system design requirements for enhanced counter-air capability (ECAC) and conduct an electromagnetic compatibility (EMC) analysis of a counter-air weapon system in support of US Army Air Defense Artillery School (USADASC). -Conduct RF effects investigation & experiments of selected target(s) of interest to TRADOC, CECOM RDEC, and Joint Live Fire Test & Evaluation (JLFT&E) office. -Complete the design of EM shielding components for the High Mobility Multipurpose Wheeled Vehicle (HMMWV) shelter for NRDEC. -Identify, evaluate and consult on FXXI Land Warrior electronic systems for NRDEC. -Conduct research into new weapon systems with tunable capabilities for lethal, non-lethal, anti-personnel, and anti-materiel applications in support of ARDEC for the AAN. - Provide expertise to Army RDECs, PMs, DoD IG, TRADOC, and intelligence community regarding DE threat environments, effects, and hardening technology insertion. -Complete design of beam stick and output cavities for high average power broadband klystron amplifier and report on possibilities for size and weight reduction. -Conduct theoretical study of electron beam dynamics in linear beam tubes such as Reltron and klystron. -Develop/acquire full complement of linear beam design and simulation codes. -Design antennas such as high power small element arrays for use on Army platforms and field tests. -Conduct theoretical study of broadband klystron amplifiers for Army applications. -Support RDEC demos and application studies. -Validate benign and threat effects Abrams and Longbow Apache information flow models, and transfer to U.S. Army Communications and Electronics Command's (CECOM's) suite of System Performance Models. -Develop new test and simulation methods to study the effects and mitigation of RF-DEW on military and commercial systems.
•	36	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	2826	

FY 2000 Planned Program:

•	3016	-Perform RF effects investigation of threat UAVs to support US Army Air Defense Artillery School. -Conduct RF effects investigation and experiments of selected target(s) of interest to TRADOC, CECOM RDEC, and Joint Live Fire Test and Evaluation (JLFT&E) office. -Support WMRD in the fabrication of a composite High Mobility Multipurpose Wheeled Vehicle (HMMWV) shelter, conduct shielding effectiveness tests, and support RF mitigation efforts undertaken by NRDEC for the Future Land Warrior technologies. -Conduct RF DEW effects and mitigation investigations of selected First Digitized Division systems in conjunction with ARL-SLAD and in support of the digital force survivability.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability / PROJECT: A140

FY 2000 Planned Program: (continued)

-Conduct research into new weapon systems with tunable capabilities for lethal, non-lethal, anti-personnel, and anti-materiel applications in support of ARDEC for the AAN.
- Provide expertise to Army RDECs, PMs and TRADOC regarding DE threat environments, effects, and hardening technology insertion.
-Initiate designs for size/weight reduction of linear beam tubes (e.g. Reltrons) for Army applications.
-Complete designs for series of experimental Reltron linear beam tubes.
-Develop designs for principal broadband amplifier components including diode, cavities, and beam stick.
-Develop short pulse (ultra wide band) antennas and techniques for Army applications.
-Support RDEC demos and application studies.

Total 3016

FY 2001 Planned Program:

- 3211 -Perform detailed design of enhanced counter-air capability for TRADOC and CECOM.
-Conduct RF effects investigation and experiments of selected target(s) of interest to TRADOC, CECOM, RDEC, and Joint Live Fire Test and Evaluation (JLFT&E) office.
-Support NRDEC RF mitigation efforts in standard shelter design and Future Land Warrior technologies.
-Conduct RF DEW effects and mitigation investigations to assure survivability of US Forces on the digital battlefields of the future.
-Conduct research into new weapon systems with tunable capabilities for lethal, non-lethal, anti-personnel, and anti-materiel applications in support of ARDEC for the AAN.
- Provide expertise to Army RDECs, PMs and TRADOC regarding DE threat environments, effects, and hardening technology insertion.
-Complete first stage designs for size/weight reduction of linear beam tubes.
-Construct experimental designs for series of broadband klystron amplifier experiments.
-Design a high gain, broadband antenna or antenna system for high power applications.
-Support RDEC demos and application studies.

Total 3211

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602120A Sensors and Electronic Survivability

PROJECT: A142

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
A142 Passive Millimeter Wave (MMW) Camera	4683	0	0	0	0	0	0	0	0	4683

Mission Description and Justification: This is a Congressionally funded program, not part of the Army's core mission funded program. The goal is to develop technology for a passive/active MMW imaging system and to demonstrate its performance capabilities as a covert all-weather surveillance and target acquisition system. Research is also performed on enabling MMW technologies in support of passive/active MMW imaging. These funds have been provided to ARL as a result of Congressional interest for the development of a Passive MMW Camera (PMC). The FY98 funds complete the assembly of a flight-worthy PMC on an airborne test platform that may allow map-of-the-earth navigation and obstacle avoidance, reconnaissance, landing guidance, and search and rescue mission scenarios under conditions of adverse weather.

FY 1998 Accomplishments:

- 4683 - Completed development of a flight worthy passive millimeter wave (MMW) imaging system for integration into an airborne test platform.
  - Completed development of enabling MMW antenna and receiver technologies for sensor systems.

Total 4683

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602211A Aviation Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	22698	24943	30165	31184	31559	31816	33448	33477	Continuing	Continuing
A47A Aeronautical and Aircraft Weapons Technology	20023	21853	26904	27616	27878	27965	29395	29273	Continuing	Continuing
A47B Vehicle Propulsion and Structures Technology	2675	3090	3261	3568	3681	3851	4053	4204	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objective of this program element (PE) is to conduct applied research in rotary wing vehicle (RWV) technologies for transition to advanced development technology demonstrations that support development of new and / or upgraded DoD / Army rotorcraft systems in support of Joint Vision 2010 and Army After Next. RWV offer a practical solution to many of the DoD / Army's operational needs because of their ability to take off and land vertically and to operate efficiently and effectively at or below tree top level for nap-of-the-earth (NOE) missions. Accordingly, RWVs present unique design challenges and require significantly different analysis compared with traditional fixed wing vehicles, which do not have rotors and do not hover or fly in NOE. The Army Aviation Science and Technology program's functional organization, supported by the National Aeronautics and Space Administration (NASA) at three co-located activities, is the focal point for DoD efforts in rotorcraft technology. Technical areas include aeromechanics, aerodynamics, flight controls, aeroacoustics, structures, propulsion, reliability and maintainability, safety and survivability, mission support equipment, aircraft system synthesis, advanced helicopter analysis, flight simulation, aircrew-aircraft integration, avionics and aircraft weapons integration. The work in this PE is consistent with the Department of Defense Technology Area Plans, DoD Joint Warfighting Science and Technology Master Plan, DoD Reliance Agreements (for which the Army is the lead service for the development of rotorcraft science and technology), the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and coordinated government / industry / academia RWV Technology Development Approach. This PE also supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry and academia, whose primary objective is to ensure the continued superiority of U.S. military rotorcraft systems through focused technology projects with a near term (2-3 year) return on investment, enabling rapid technology insertion into military and commercial rotorcraft. The Army and NASA provide funding for NRTC which is at least matched by industry. Army, NASA, Navy, and Federal Aviation Administration (FAA) provide staffing and support for the NRTC operations. Technology developed in this PE will support the future DoD Joint Transport Rotorcraft (JTR) identified to potentially replace the aging Army CH4-7D Chinook and Navy CH-53 Super Stallion helicopters. Upgrade activities [as applicable] of Army systems such as the AH-64 Apache, RAH-66 Comanche, UH-60 Blackhawk, Navy SH-60 Seahawk and USMC AH-1 Cobra are supported as well.

Work in this PE is performed by contractors including Boeing Company, Mesa, AZ and Philadelphia, PA; Bell Helicopter Textron Incorporated, Ft. Worth, TX; Lockheed Martin, Atlanta, GA; General Electric, Lynn, MA; AlliedSignal Engines, Phoenix, AZ; Sikorsky Aircraft, Stratford, CT; Rolls Royce, Indianapolis, IN; Kaman Aerospace Corp., Bloomfield, CT; Pratt & Whitney, Hartford, CT; Raytheon STX, Washington, D.C.; and United Technologies Research Center, Hartford, CT. Additionally, work in this PE is performed by universities including Arizona State University, AZ; Georgia Institute of Technology, GA; Naval Postgraduate School, Monterey, CA; California Polytechnic University, San Luis Obispo, CA; Ohio State University, OH; Penn State University, PA; Purdue University, IN; Texas A&M, TX; University of Southern California, CA; University of Florida, FL; University of Illinois, IL; University of Maryland, MD; University of Michigan, MI; University of Utah,

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602211A Aviation Technology

UT; Virginia Polytechnic Institute and State University, VA; Wichita State University, KS; Cornell University, NY; Iowa State University, IA; Prairie View A&M College, TX; University of Dayton, OH; University of Texas Automation and Robotics Institute, TX; University of Alabama, Huntsville.

Primary in-house developers include Aviation and Missile Command (AMCOM), Redstone Arsenal, AL; Aeroflightdynamics Directorate / AMCOM, NASA Ames Research Center, Moffett Field, CA; Aviation Applied Technology Directorate / AMCOM, Ft Eustis, VA; Vehicle Technology Center (VTC) /Army Research Laboratory (ARL), NASA Langley Research Center, Hampton, VA; and Vehicle Technology Center / ARL, NASA Lewis Research Center, Cleveland, OH.

Technology products from this PE directly transfer to technology demonstrations conducted under PE 0603003A (Aviation Advanced Technology). Joint coordination of efforts, where applicable, is conducted with the NASA Aeronautics Program; PE 0602122N, Aircraft Technology; and PE 0602201F, Aerospace Flight Dynamics. To eliminate duplication, the PE efforts are coordinated throughout the rotorcraft community by joint program reviews, exchange of program data sheets, research and technology resumes, technical reports; inter-service liaison; government/industry/academia participation in the annual program development and refinement process for NRTC projects; attendance at scientific meetings and conferences; participation in the Joint Aeronautical Commander's Group, The Technical Cooperation Program (TTCP), NASA Research and Technology Committees, and the North Atlantic Treaty Organization (NATO) Advisory Group on Aerospace Research and Development (AGARD). Efforts under this PE transition to and provide risk reduction for Demonstration / Validation and Engineering Development programs supported by PE 0603801A (Aviation - Advanced Development), PE 0604801A (Aviation - Engineering Development) and PE 0604270A (Electronic Warfare Development). Some efforts also transition to the field through PE 0203752A (Aircraft Engine Component Improvement Program). In addition, this PE's deliverables provide technical support to PE 0604223A (RAH-66 Comanche), PE 0604816A (AH-64D Longbow Apache), and PE 0203744A (Aircraft Modifications / Product Improvement). Active joint Service programs supported: The Tri-Service Integrated High Performance Turbine Engine Technology (IHPTET) program and Navy / Army Joint Advanced Health and Usage Monitoring System (JAHUMS) Advanced Concept Technology Demonstration (ACTD) program. International Cooperative Agreements include Information Exchange Agreements with the Netherlands, Israel, Japan, Germany, France and the United Kingdom (UK).

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	22211	29746	30041	31734
Appropriated Value	22982	25160		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-771	-217		
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reductions	-13			
d. Below Threshold Reprogramming	500			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+124	-550
Current Budget Submit (FY 2000 / 2001 PB)	22698	24943	30165	31184

Change Summary Explanation: Funding – FY 1999 program reduced by Congress (-4586).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602211A Aviation Technology / PROJECT: A47A

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A47A Aeronautical and Aircraft Weapons Technology	20023	21853	26904	27616	27878	27965	29395	29273	Continuing	Continuing

Mission Description and Justification: The purpose of this project is to conduct applied research of technologies for DoD / Army RWV systems improvements in operational effectiveness and combat mission capability including increased strategic and tactical mobility / deployability, air-to-ground and air-to-air combat, improved fire power, increased aircraft and aircrew survivability, increased reliability and reduced maintenance, and increased combat sustainability. Work in this project maintains world excellence in rotorcraft technology through the study of advanced technologies and their applications to rotorcraft. Areas of investigation and research consist of the following: fluid mechanics, dynamics, aerodynamics, advanced flight control technology, handling qualities, aircraft avionics and weapons interaction, Infrared (IR) / visual electro-optical (EO) and acoustic signatures reduction, weight reduction, advanced materials applications, internal / external loads, militarization of propulsion / structures technology, engine specific component technologies in support of the DoD Integrated High Performance Turbine Engine Technology (IHPTET) initiative goal demonstrators, advanced smart materials applications, flight simulation, improved aircrew / machine integration and pilot-vehicle interface, improvements in reliability and maintainability, combat damage repair of new materials, vulnerability reduction to Nuclear Biological Chemical (NBC), ballistic, and advanced energy threats, crashworthiness, and logistics reductions. These technologies are being developed for application to current as well as future DoD / Army rotorcraft systems. This project also supports work done under the auspices of the National Rotorcraft Technology Center (NRTC). NRTC addresses five critical military / civil rotorcraft technology thrusts as follows: (a) process and product improvement for affordability, quality and environmental compliance; (b) enhanced rotorcraft performance; (c) passenger and community acceptance; (d) expanded rotorcraft operations; (e) technologies to support harmonized military qualification and civil certification. NRTC projects are identified and developed by industry and evaluated and approved by government on an annual basis to ensure they are supportive of DoD rotary wing goals and objectives.

FY 1998 Accomplishments:

- 6462 - Completed integration and testing of research flight control system components on the Rotorcraft Aircrew Systems Concepts Airborne Laboratory (RASCAL) in-flight simulator (a modified UH-60 helicopter) which will support active flight control demonstrations.
  - Completed and released beta evaluation version of the Control Designer's Unified Interface Tool (CONDUIT) to US rotorcraft manufacturers, which provides a capability to significantly reduce in rotorcraft flight control system development time.
  - Developed cyclic control envelope limiting and queuing in vertical motion piloted simulation, and documented work for transition to the Helicopter Active Control Technology (HACT) program
  - Analytically developed multi-element hi-lift airfoil with reduced drag characteristics as a candidate concept for the variable geometry rotor. Developed design for active-elevon controlled model rotor for vibration control. Completed optimized blade aerodynamic geometry for the Advanced Configuration Rotor (ACR) test article to improve rotor efficiency, reduce noise and vibratory loads. Benchmarked rotor air load prediction capability
  against prediction effectiveness metric required for efficient design of variable geometry rotors.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602211A Aviation Technology
	PROJECT A47A

- Completed redesign of Man-machine Integrated Design Analysis System (MIDAS) cockpit design tool with new human operator cognitive models and performed part-task simulation studies to verify situation awareness measured predictions.
- Produced draft standard for helmet mounted symbology based on tri-service research in symbology design, dynamics, resolution, and referencing.

FY 1998 Accomplishments: (Continued)

- 1475 - Performed Integrated Flight Fire Control (IFFC) evaluation and simulation to quantify improvements in target engagement timelines and accuracy.
  - Conducted Airborne Manned / Unmanned Systems Technology (AMUST) performance integration trade studies needed for system definition and development.
- 1500 - Identified improvements needed to tailor existing crashworthiness predictive codes to Army rotorcraft, thereby reducing the development time/cost of future rotorcraft modifications.
  - Developed and tested 0-256 kHz laser interferometer to support acoustic drive train monitoring.
- 1500 - Provided man-machine integration support to Rotorcraft Pilot Associate.
- 2962 - Performed bond testing of lightweight all-composite joints to validate their structural integrity; fabricated and tested sub-components of metal matrix landing gear to decrease weight; conducted structural dynamic modeling of airframe fittings for improved structural integrity; developed closed-loop cure process to compensate for resin age and variability for improved structural integrity; conducted structural dynamic modeling of airframe fittings for improved structural weight; performed screening tests of advanced polymeric based leading edge materials for low dielectric rotor blade sand / rain erosion protection; defined matrix of advanced engine IR suppression concepts via computational fluid dynamics (CFD) flowfield analysis.
- 995 - Completed design of monolithic ceramic low pressure (LP) turbine airfoil and attachment configuration consistent with IHPTET / Joint Turbine Advanced Gas Generator (JTAGG) Phase III providing higher temperature capability and increased horsepower to weight ratio; completed design of advanced high pressure (HP) reduced stage compressor for IHPTET / JTAGG Phase III providing higher pressure ratio, reduced specific fuel consumption and reduced O and S costs; conducted preliminary design of inter-metallic composite (IMC) spar / shell HP turbine blade; conducted fabrication trials of Army / Air Force cooled ceramic matrix composite (CMC) turbine vane.
- 4200 - Completed component development / test / validation and transition of NRTC technology to government / industry partners from: Health and Usage Monitoring System (HUMS) diagnostic database, resin transfer molded tailrotor blade, main rotor pitch case testing, automated rotor blade surface finish process, high speed blade core carving process, composite swashplate design; tiltrotor groundwash model tests, active horizontal tail control flight test, rotor / antenna interaction prediction model, helicopter maneuver loads data analysis; interior noise reduction isolator mount and prediction methodology, gear design methods testing; simulator evaluation of synthetic vision and decision aiding tools, water and soil crash dynamics and crashworthy fuel tank methodology.
  - Conducted NRTC Applied Research efforts in the areas of low cost and efficient composite structures, reduced manufacturing and operating costs, active flight controls, increased reliability and flight safety, Master Cure Simulation System, enhanced vehicle performance, noise and vibration reduction, noise certification metric and ultrasafe drivetrain design with an emphasis on technologies validation and technology transition.
- 929 - Provided payment for Defense Finance and Accounting System (DFAS) services.

Total 20023

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602211A Aviation Technology / PROJECT: A47A

FY 1999 Planned Program:

- 6866 - Perform sling-load flight-test studies to develop potential for sling load envelope prediction and determine critical handling-qualities criteria.
  - Validate and optimize RASCAL control laws prior to flight testing of research actuation system using CONDUIT methods and Rapid Prototyping Simulation Environment (RIPTIDE).
  - Evaluate oscillatory blade blowing concept to substantially improve rotor stall margins and increase maximum blade loading; evaluate ACR to improve rotor efficiency and reduce loads; use hybrid computational methods to develop approaches for reducing rotorcraft adverse aerodynamic forces and increasing range and speed.
  - Conduct preliminary verification, validation and accreditation for MIDAS human operator models.
  - Perform simulation evaluation of situation awareness measures to minimize spatial disorientation and improve symbology designs; transition results to RAH-66 Comanche and future rotorcraft systems**.**
- 500 - Conduct preliminary design studies for advanced rotor core concepts, including on-blade control, high-lift devices, active twist, and variable diameter rotor to guide critical component fabrication and evaluation.
- 1930 - Conduct preliminary design studies for advanced aerial rocket-to-aircraft integration concepts.
  - Complete airborne unmanned-to-manned systems definition / integration trade study and transition results to 6.3 flight demonstration.
  - Conduct preliminary design for multi-role aviation gun system integration concept for transition to 6.3 flight test demonstration
  - Analyze rotorcraft user avionics requirements, pertinent OSD open systems directives, industry Contractor Off The Shelf (COTS) plug and play common modules and reusable software to identify technical issues and preliminary design criteria for low-cost, common open system architecture solutions.
- 1871 - Conduct test of aluminum matrix landing gear components to verify crashworthiness; select high temperature tolerant material systems for rotorcraft dynamic components for improved environmental durability; conduct testing on composite fuselage joints to validate structural integrity; develop methods to co-cure complex composite rotorblades to reduce cost.
- 1355 - Complete fabrication of ceramic LP turbine providing higher temperature capability and increased horsepower to weight ratio; conduct rig testing; fabricate advanced HP compressor for IHPTET / JTAGG Phase III; complete design of IMC spar / shell HP turbine blade providing higher temperature capability and increased horsepower to weight ratio; complete preliminary design of high strength, lightweight shaft for JTAGG III; fabricate finalized design of an Army / Air Force cooled CMC HP turbine vane.
- 3148 - Complete evaluation of ceramic and polymer based leading edge materials for low dielectric, long life rotor blade protection in sand and rain environments.
  - Bench test preliminary high-efficiency engine IR suppressor that reduce engine performance penalty to signature reduction ratio by 50%.
- 4934 - Complete component development / demonstration / test / validation and transition of NRTC technology to government / industry partners from: corrosion sensors evaluation; integrated helicopter design architecture and tools; composite swashplate fabrication; validated interior noise reduction methodology, models, and mounts; flight test of decision aiding system; large eddy simulation of complex rotorcraft flows; tail buffet alleviation; fatigue behavior of a selectively reinforced aluminum matrix fitting; high speed machining of airframe structures; thermoset materials; low cost fasteners and installation for composites; melt-bond joint technology; and composite life prediction methodology.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602211A Aviation Technology / PROJECT: A47A

FY 1999 Planned Program: (continued)

-Continue NRTC Advanced development efforts in noise certification procedure; water and soil crash dynamics; crashworthy fuel tank design concepts / criteria; active side stick controllers; smart and multifunction rotorcraft antennas; flight management computer technology; and rotorcraft collision avoidance technology

- 933 - Provide payment for DFAS services.
- 316 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 21853

FY 2000 Planned Program:

- 6991 - Evaluate CONDUIT / RIPTIDE-optimized flight control laws using the RASCAL in-flight simulator.
  - Validate partial authority flight control concepts, providing attitude command/attitude hold capability with existing partial authority actuators.
  - Create and analyze conceptual designs of advanced rotorcraft in response to evolving AAN operational concepts. Provide characteristics of these designs for input to war game simulations.
  - Continue verification, validation and accreditation for MIDAS human operator models. Transition tool to industry through cooperative R&D agreements.
  - Perform in-flight validation of advanced situation awareness and HMD evaluation methods in Cobra in-flight simulator.
  - Develop and / or tailor government / industry low cost, common, open system architecture design standards and specifications for DoD rotorcraft platform avionics.
- 7595 - Evaluate VGART core concept applicability based on small- scale demo testing; conduct parametric analysis to determine core concept technology mix potential for transition to Variable Geometry Advancer Rotor Demonstration (VGARD) program.
  - Fabricate large-scale critical components and begin bench tests for VGART core concept candidates.
  - Evaluate core concept initial wind tunnel data to guide variable geometry rotor candidate selection and prioritization for VGARD.
- 2019 - Fabricate complex rotor components in single co-cure to demonstrate lower production cost; conduct durability tests of drive shafts to demonstrate high temperature capability; select smart rotor control concept for improved blade performance; design primary structural concepts for ballistic protection.
- 1330 - Complete rig testing of ceramic LP turbine; conduct combined rig testing of advanced HP compressor for IHPTET / JTAGG Phase III; conduct rig validation testing of Army / Air Force cooled CMC HP turbine vane; complete detailed design of high strength, lightweight shaft for JTAGG III; conduct detailed design of advanced CMC JTAGG III combustor providing higher temperature capability and increased horsepower to weight ratio.
- 2769 - Complete preliminary concept screening, design and fabricate light weight, high-efficiency engine IR suppressor components that reduce suppressor weight by 20%
  - Conduct detailed comparisons of predictive vs. test structural behavior based on results full-scale ACAP crash tests and execute code modifications if necessary; perform component test and evaluation to support digitally-controlled crashworthy landing gear strut for 40% increased gear energy absorption; perform analysis of crashworthy fuel system components and alternative materials to support 30% system weight reduction.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602211A Aviation Technology
	PROJECT: A47A

FY 2000 Planned Program: (Continued)

- 6200 - Complete component development / test / validation and transition of NRTC technology to government / industry partners from: helicopter maneuver loads, active/passive noise control technology for helicopter interiors, helicopter cabin noise control methodology, resin transfer molded tailrotor blade, planetary ring gear isolation, enhanced aeromechanical stability, high speed blade core carving process, tiltrotor vibration stabilization, vibration benefits analysis helicopter exterior noise reduction, simulator evaluation of synthetic vision and decision aiding tools, water and soil crash dynamics, crashworthy fuel tank methodology, and vibration/stress reduction in airframes.
  - Conduct NRTC technology efforts in the areas of low cost and efficient composite structures, reduced manufacturing and operating costs, integration of helicopter design tools, reliability assessment, multidisciplinary optimization and multi-mission sizing.

Total 26904

FY 2001 Planned Program:

- 7311 - Demonstrate high-agility flight control using rotor state feedback in the RASCAL in-flight simulator providing 15% increase in maneuverability/agility.
  - Conduct vertical motion simulation of external cargo load stabilization allowing higher operational speeds with sling loads.
  - Complete analytical /simulation study of benefits of on-blade control using CONDUIT/RIPTIDE tools.
  - Provide expert analysis and critique of advanced platform designs from the rotorcraft community and assess their applicability to DoD needs.
  - Incorporate human modeling modifications into MIDAS identified by prior year evaluation testing.
  - Demonstrate reductions in crewstation design cycle and crewmember error potential resulting from full-scale application of MIDAS tool.
  - Complete development and tailoring of government / industry low cost, common, open system architecture design standards and specifications based on COTS plug and play common modules and reusable software for rotorcraft platform avionics
- 7023 - Complete bench and wind tunnel testing of critical components for variable geometry rotor core concept technologies.
  - Formulate, select, and recommend rotor system technology configuration for the Variable Geometry Advanced Rotor Demonstration (VGARD) program.
  - Conduct active on-blade control loads modeling tools upgrade for transition to 6.3 VGARD concept mix and pre-design requirements.
- 2530 - Conduct full-scale validation testing of complex, smart rotor components to demonstrate structural integrity and cost reduction; fabricate sub-scale structural armor specimens for ballistic testing.
-
- 1480 - Complete fabrication of advanced CMC JTAGG III combustor; perform combined CMC combustor/CMC turbine vane rig test for validation of JTAGG III life requirements; complete fabrication of high strength, lightweight shaft for JTAGG III.
- 2855 - Demonstrate full-scale, light weight, high-efficiency engine IR suppressor; perform low-energy dynamic impact testing of digitally-controlled crashworthy landing gear strut; perform coupon impact testing of alternative crashworthy fuel system components/designs for system weight reduction; perform conceptual analyses of advanced ballistic protection techniques for Army rotorcraft to achieve 15% net reduction in installed armor weight.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602211A Aviation Technology	PROJECT A47A

- Screen low glint canopy coating material specifications.

FY 2001 Planned Program: (Continued)

•	6417	- Complete component development / test / validation and transition of NRTC technology to government/industry partners from: design for tiltrotor noise reduction, tiltrotor performance enhancement, crash safety, damage tolerance for helicopter structures, behavior of fastened airframe joints, high temperature composite applications, composite nondestructive testing, resin properties affecting marcel generation, low cost composite structures, high speed machining of titanium composites, and high speed blade core carving. - Continue NRTC technology efforts in advanced rotor ice protection system, low noise and improved bearing contact bevel cages, rotorcraft antenna technologies, variable speed vapor cycle cooling system, helicopter decision aiding system, floatation loads and stability of aircraft, helicopter operations and approaches, noise abatement and standards simplification, and tiltrotor operations and approach developments.
Total	27616	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602211A Aviation Technology

PROJECT: A47B

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A47B Vehicle Propulsion and Structures Technology	2675	3090	3261	3568	3681	3851	4053	4204	Continuing	Continuing

Mission Description and Justification: The purpose of this project is to conduct applied research of generic propulsion and structures technology in support of DoD / Army Rotary Wing Vehicle (RWV) improvements. Areas of investigation and research include concepts of: small airflow gas turbines; high temperature materials; mechanical drive systems; integrated composites structural integrity; low cost manufacturing concepts; aerodynamic loads; and aeroelastic interactions. The propulsion technology in this project supports the goal of the DoD Integrated High Performance Turbine Engine Technology (IHPTET) / Joint Turbine Advanced Gas Generator (JTAGG) program and the Army Aviation Research, Development and Engineering Center (RDEC). The goal of IHPTET is to demonstrate technology which would double propulsion system capability for a wide range of potential future RWV applications.

FY 1998 Accomplishments:

- 1552 - Completed performance testing and Average Passage (APNASA) analysis of the final configuration of the advanced 2-stage high pressure ratio axial compressor, which will aid in design of lighter weight and less costly high compression engines by reducing the number of required stages.
  - Completed the development of a waverotor operating map and characterized the waverotor start-up process. This is an alternative technology path that avoids some of the material and fluid dynamic technology barriers of turbomachinery.
  - Conducted aerodynamic and heat transfer tests for advanced transonic turbine blading to enable development of more efficient turbine cooling designs.
  - Completed seeded fault diagnostic / prognostic spiral bevel gear tests which will validate crack propagation prediction codes for use in future advanced lightweight gear designs.
  - Developed stable operation of high temperature magnetic bearings hardware that will enable operation of critical gas turbine mechanical components in the environmental conditions projected for IHPTET / JTAGG Phase III.
  - Provided methodology and design for control of the compressor stability enhancement system to achieve increased engine operating efficiency.
- 1123 - Prepared soft-inplane hub for the Langley tiltrotor model and completed hover tests, developed baseline rotor system for evaluation of aeroelastic tailored rotor for low vibration, and constructed one integral active-twist 'proof-of-concept' blade in preparations for hover tests in FY99.
  - Updated Finite Element Model (FEM) of the all composite Beechcraft Starship with accurate prediction of the first seven natural frequencies.
  - Validated Innovative Fuselage Concept design for crashworthiness using sub-scale specimens in preparation for full-scale test in FY99.
  - Completed fatigue tests on structural panels to validate fatigue life and crack growth rates of actual riveted aircraft structures.
  - Developed FEM based on solid-to-shell transition elements for debond analysis of stitched interface.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602211A Aviation Technology
	PROJECT A47B

- Developed NDE data fusion software using probability based criteria for combining different methods to classify defects; validated durability and damage tolerance models for composite structures; evaluated NDE methods to measure strength of bonded structures.

Total 2675

FY 1999 Planned Program:

- 1763 - Complete speed and durability testing of oil-free bearing and seal technologies for revolutionary oil-free auxiliary power units and aeropropulsion engines.
  - Develop readiness of micro electromechanical systems (MEMS) micro sensor and actuator technology applied to engine components for control and diagnostic purposes which will improve lightweight engine performance and reliability.
  - Complete analysis and performance testing of an advanced compressor stage for IHPTET / JTAGG Phase III.
  - Conduct validation tests on thermal behavior of high speed gearing in support of advanced lightweight gearing systems.
  - Complete high temperature rig testing of magnetic bearings system.
  - Design and fabricate waverotor topped gas turbine integration experiment.
- 1310 - Evaluate soft-inplane tiltrotor system versus conventional stiff-inplane configuration in the Langley tunnel and evaluate active twist concept for vibration reduction potential in the Transonic Dynamics Tunnel.
  - Incorporate 'Regenerative Electronics' technology power and control into Aeroelastic Rotor Experimental System to reduce power required for on blade active control applications.
  - Acquire modal data for a baseline Aluminum Cylinder (ATC) for correlation with FEM.
  - Develop and test full scale crashworthy fuselage with chosen energy absorbing subfloor.
  - Fabricate and test low-cost structurally efficient concepts for helicopter fuselages.
  - Transition prototype instrument for bond strength measurements.
- 17 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3090

FY 2000 Planned Program:

- 1844 - Couple a waverotor with a simulated gas turbine engine rig and developed a successful solution to the most challenging waverotor/turbomachinery integration issues.
  - Develop advanced concept configuration for close coupled, compact compressor system; complete multi-stage CFD analysis of configuration.
  - Complete design and fabrication of cooled ceramic matrix composite turbine nozzle airfoils for application to IHPTET/JTAGG phase III.
  - Complete high temperature testing of back-up bearing system to be incorporated into the high temperature magnetic bearing system.
  - Complete design and analysis of oil-free small turbine engine..

- Complete database for face gear design stress allowables, thereby enabling design and development of revolutionary light weight helicopter drive systems.

- 1417 - Investigate active control technology for stability augmentation, conduct first tests of 'active twist' rotor for vibration control, and validate passive structural tailoring concept with model rotor test in Langley tunnel.
  - Test 'on-blade' aerodynamic active control devices for vibration reduction in Langley tunnel.
  - Conduct experimental program and collect modal test data of the all composite Sikorsky helicopter.
  - Complete tension-torsion fatigue testing of Bell ducted tail rotor flexbeam.

FY 2000 Planned Program: (Continued)

- Establish design methodology for compression damage tolerance of impacted composite sandwich panels supporting airframe structural integrity, durability, and reliability. Also supports NASA DEAR program.
- Develop and conduct element and component tests of tailored structures to support RWST demonstration.

Total 3261

FY 2001 Planned Program:

- 1986 - Conduct performance and particle image velocimetry (PIV) experiments on close coupled compact compression system to validate fluid dynamic concepts developed in FY 00.
  - Complete performance testing of waverotor topped gas turbine demonstration cycle, thereby verifying enhanced fuel efficiency and power density predicted in cycle analyses.
  - Complete thermomechanical fatigue structural durability testing of cooled ceramic matrix composite turbine nozzle airfoil to support IHPTET readiness requirements.
  - Complete performance testing and verify loss-of-lubrication tolerance of advanced helical gear drive system.
  - Develop surface fatigue database for diamond like coated spur gears.
- 1582 - Collaborate with Industry in aeroelastic stability evaluation of Variable Diameter Tiltrotor concept in Langley Tunnel.
  - Complete tests of 'active twist' rotor blade control for vibration in the Langley tunnel, and investigate potential for active twist as primary control for swashplateless rotor.
  - Conduct experiments on finite element model of composite helicopter and correlate with modal test data.
  - Predict Boeing-Mesa main rotor flexbeam fatigue life. Supports RWST and the NASA DEAR program.
  - Complete element and component tests of tailored structures in support of RWST program.
  - Validate strength and stiffness predictions of tailored structures.

Total 3568

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602270A Electronic Warfare (EW) Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	15927	16116	17487	18082	18433	18797	21054	22196	Continuing	Continuing
A442 Tactical Electronic Warfare Technology	8781	9353	9595	9924	10133	10369	11481	12085	Continuing	Continuing
A906 Tactical Electronic Warfare Techniques	7146	6763	7892	8158	8300	8428	9573	10111	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program investigates electronic warfare (EW) technologies for current and future systems. The efforts in EW will enable the Army to deny the enemy use of the radio spectrum for command, control, communications and computer intelligence purposes, and provide a decisive advantage to our operational forces against the full range of traditional and non-traditional threat forces. Electronic countermeasures (ECM) and self protection developments will protect Army forces from a broad range of radio frequency (RF) surveillance/tracking systems, imaging radars, advanced RF/ electro-optical infrared (EOIR) missiles, and smart munitions. Applied research is also being done in the area of using automated intelligence fusion techniques and developing automated battlefield asset management tools. Work in this program will lead to winning the battlefield information war by controlling the electromagnetic spectrum and conducting successful electronic disruptive/destructive measures to threat mission planning. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), Science and Technology Objectives (STOs) and the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on intelligence and electronic warfare. It is related to and fully coordinated with efforts in PE 0602782A (Command, Control and Communications (C3) Technology), PE 0602709A (Night Vision and Electro-Optics Technology), PE 0603789F (C3 Intelligence Technology Development), PE 0603270A (Electronic Warfare Technology), PE 0604270A (Electronic Warfare Development), and PE 0603745A (Tactical Electronic Support Systems - Advanced Development) in accordance with the ongoing Reliance joint planning process. This program is primarily managed by Communications-Electronics Research, Development and Engineering Center (CERDEC), Fort Monmouth, NJ.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602270A Electronic Warfare (EW) Technology

B. Program Change Summary:	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	18925	16249	17699	18221
Appropriated Value	19528	16249		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-603	-133		
b. SBIR / STTR	-141			
c. Omnibus or Other Above Threshold Reductions	-2857			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-212	-139
Current Budget Submit (FY 2000 / 2001 PB)	15927	16116	17487	18082

Program Change Summary Explanation: FY1998 funds in project A936 (-2857) reprogrammed to PE 0604270A, Electronic Warfare Development to more accurately reflect the work being accomplished in support of the Shortstop Electronic Protection System.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602270A Electronic Warfare (EW) Technology — PROJECT: A442

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A442 Tactical Electronic Warfare Technology	8781	9353	9595	9924	10133	10369	11481	12085	Continuing	Continuing

Mission Description and Justification: This project performs applied research on electronic warfare sensor and countermeasure (CM) technologies for self protection of air and ground platforms, area protection against radar-directed weapons (i.e., jamming of enemy counter mortar/counter battery radars), combat surveillance and target acquisition. The following technology areas are investigated:

- Infrared countermeasures (IRCM) technologies that provide air and ground platforms with the capability to detect and jam heat-seeking surface-to-air missiles and anti-tank guided missiles with active infrared (IR) sources, or to decoy them with flares or other devices.
- Self-protection radar countermeasures/warning technologies that provide air and ground platforms with warning and jamming against radar-directed air defense weapons, and jamming of top attack/smart munitions/ artillery-delivered radio proximity fuses.
- Laser warning and countermeasures technologies that provide air and ground platforms with laser rangefinder and designation warning and jamming capability against laser-aided and electro-optically-directed threats including laser beamrider missiles.
- Fusion and correlation of missile and radar warning data to assist in the location and identification of threats and increase situation awareness.
- Electronic support (ES) technologies that provide the capability to intercept, direction find, and locate current and emerging hostile non-communications emitters for targeting and tactical situational awareness for ground, man-portable and unmanned aerial vehicle (UAV) applications.
- Area protection radar countermeasure technologies that provide radar stand-off and stand-in jamming and deception in support of ground forces.

FY 1998 Accomplishments:

- 2900
  - Tested low cost specific emitter identification, location and targeting techniques in coordination with Naval Research Laboratory Survivability Integration Laboratory (SIL) established link to Ft. Rucker's aviation testbed for user evaluation and doctrine development for new electronic warfare technologies and capabilities.
  - Completed development of phased array radar digital model to support countermeasure techniques.
- 3786
  - Developed key technology requirements for a multispectral sensor module for radio frequency (RF) and missile warning to replace multiple sensors on aircraft and vehicles.
  - Completed the tri-service development of the digital advanced "generic" IR missile to support the multispectral countermeasures demonstration.
- 2095
  - Performed laboratory demonstrations of the low probability of intercept (LPI) appliqué receiver and the high-speed impulse detector. These will enable the common module electronic intelligence (ELINT) system (CMES) to perform rapid detection, characterization and direction finding of low-power impulse emitters.
  - Demonstrated capability to detect and process impulse signals from an airborne platform.
  - Developed technology to deceive imaging, meteorological, and non-conventional sensors and perform laboratory demonstration of prototype.

FY 1998 Accomplishments: (continued)

– Performed experiments to test the use of ELINT systems to cue synthetic aperture radar (SAR) for target detection and imaging over a wide area. Results indicate that mission search times can be reduced by a factor of 200 using this technique.

Total 8781

FY 1999 Planned Program:

- 3215 – Complete development of techniques for precision direction finding of ultra-high frequency (UHF) and millimeter wave (MMW) air defense surveillance and targeting radars.
  – Verify accuracy of direction finding and specific emitter identification techniques via survivability systems integration lab and joint work with the Naval Research Laboratory (NRL) transition to integrated situation awareness and targeting (ISAT) advanced technology demonstration (ATD).
  – Enhance jamming techniques against bi-static, low probability of intercept (LPI) and impulse radars.
  – Conduct field measurements of IR and UV signatures of SAMs and ATGMs.
- 2717 – Enhance development, simulation, and testing of infrared countermeasure jamming techniques against multiple imaging infrared, laser designated, and laser beam riding threats. (Coordinated NRL/Air Force Research Laboratory (ARFL) program).
  – Develop techniques to manage and optimize the combination of infrared laser jamming and decoy/flares countermeasures.
- 1000 – Complete design based on USAF C-130 research, of the fiber-optic, remote antenna assembly to improve transmission efficiency between external warning receivers and internal signal processing systems.
  – Develop low observable, multi-octave antenna technology to provide warning receivers with precision angle of arrival capability to control and direct countermeasures, and to enhance situational awareness, target cueing and emitter identification capabilities.
- 2258 – Conduct laboratory demonstrations of the adaptive matched filter receiver to improve the capability of CMES to detect/characterize modern signals in the presence of a heavy conventional signal environment.
  – Perform laboratory demonstration of electronic support measures (ESM) capability against impulse radars for Program Manager (PM) Signal Warfare.
  – Address technologies required to provide a modular, full spectrum capable electronic counter measure and electronic counter-counter measure (ECM/ECCM) UAV payload to react quickly to rapidly changing emitter Low probability of Intercept and Low Probability of Detection threats.
  – Continue development and application of ELINT cueing techniques to enable rapid detection and imaging of high priority targets, battle damage assessment, and threat avoidance over a wide area.
- 163 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 9353

FY 2000 Planned Program:

- 2338 – Design a high speed digital receiver, in conjunction with DARPA, Air force (AF), and Navy laboratories, that will provide the capability to receive, classify and support time difference of arrival (TDOA) emitter location of both radar and communications signals.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology
PROJECT A442	

FY 2000 Planned Program: (continued)

- Develop ultra wide bandwidth digital RF memory module, utilizing DARPA high-speed analog-to-digital converter technology, to generate signals to deceive and jam imaging radars, low probability of intercept, and frequency hopping air defense and surveillance radars. Coordinated development of software with NRL and AFRL for digital RF memory.

- 1925 – Enhance development of low observable, multi-octave antenna technology for upgrades to RF and missile warning systems.
  – Conduct survivability integration lab and field tests to refine multi-octave antenna design, and to support development of countermeasure management techniques.
  – Conduct trade-off analyses and simulations, and develop design alternatives for combining two or more of the missile, laser and radar warning sensors in a single modular package for application to both aircraft and ground vehicles.
- 2934 – Develop non mechanical laser beam steering techniques to improve accuracy and stability of jamming energy, simplify design, and reduce cost of laser based infrared countermeasure systems.
  – Develop multi-band ultraviolet and infrared countermeasure techniques to defeat emerging multispectral surface-to-air and air-to-air missiles.
  – Develop infrared countermeasures techniques to advanced anti-tank guided missile.
- 2398 – Address packaging, antenna, and signal processing technologies for the development of small, lightweight, remotely reconfigurable electronic support (ES) capability which employs sensor cross-cueing for precision geolocation of high value targets.
  – Develop passive millimeter wave visualization technology to improve detection of target emitters in a dense signal environment.
  – Investigate the application of low probability of intercept (LPI) algorithms to detect and geolocate spread spectrum emitters.
  – Perform simulation and modeling of ECM/ECCM effectiveness. Perform waveform analysis for threat emitters and jamming techniques for tactical or short range UAV payloads.

Total 9595

FY 2001 Planned Program:

- 2514 – Enhance high-speed digital receiver that will provide the capability to receive, classify using specific emitter identification (SEI) and support time difference of arrival (TDOA) emitter location of both radar and communications signals.
  – Continue development of ultra wide bandwidth digital RF memory module required to generate signals to deceive and jam advanced radars.
  – Develop and test wide bandwidth deception and countermeasure algorithms, waveforms, and modulation techniques to provide tactical countermeasure systems with the capability to degrade or delay the enemy's ability to locate dismounted, mounted, aviation, and forward support units with imaging radars.
- 1939 – Complete development of low observable, multi-octave antenna technology, test and characterize sensitivity and observability parameters via hardware-in-the-loop simulation.
  – Develop, integrate, and evaluate component technologies for multi-spectral missile, laser and radar warning sensors in a single modular package for application to both aircraft and ground vehicles.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology
	PROJECT A442

- 2989 – Conduct hardware-in-the-loop simulation tests of non-mechanical laser beam steering modules and techniques to improve accuracy and stability of jamming energy, simplify design, and reduce cost of laser based infrared countermeasure systems.

FY 2001 Planned Program: (Continued)

– Develop and evaluate multi-band ultraviolet and infrared countermeasure techniques to defeat emerging multispectral surface-to-air and air-to-air missiles.

– Develop and integrate compact modular, multi-band countermeasure laser based on AF developed semiconductor laser technology.

– Transition cooperative jamming and decoy/flare techniques to integrated countermeasures technology demonstration.

- 2482 – Develop electrically reconfigurable antennas for airborne and ground SIGINT platforms.

– Integrate spread spectrum receiver technology for eventual transition to countermeasure systems.

– Perform research and development to provide electronic support technology to intercept, geolocate, and counter emerging hostile non-communications emitters on the battlefield.

– Design ultra-low sidelobe antenna, adaptive power control module, and provide specific emitter identification capability for tactical or short range UAV payloads.

Total 9924

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602270A Electronic Warfare (EW) Technology

PROJECT: A906

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A906 Tactical Electronic Warfare Techniques	7146	6763	7892	8158	8300	8428	9573	10111	Continuing	Continuing

Mission Description and Justification: This applied research program involves technologies that provide the capability to intercept, direction find (DF) and locate current and emerging threat communications emitters for targeting, tactical situation awareness, and disruption/destruction of enemy command, control and communications (C3) systems. It specifically develops essential electronic attack (EA) components and techniques for advanced jammers and smaller, lower power, lightweight, common modules for advanced systems to counter communications associated with modern threat C3 systems. In addition, it will provide remote capability to intelligence and electronic warfare sensor systems with EA algorithms that enable the disruption, denial or destruction of threat communication signals. These efforts provide critical technology underpinnings for friendly force ownership of the electromagnetic spectrum. Other technology efforts performed under this program involve fusion (automated assimilation and synthesis) of battlefield intelligence data. Research and development will be conducted to provide a joint intelligence, surveillance, and reconnaissance capability at the brigade level to address operational shortfalls. On-going fusion and dissemination efforts will be leveraged to integrate data from traditional intelligence sensors and from non-traditional sources such as target acquisition systems to provide early-entry ground force commanders unprecedented battlefield awareness. User friendly intelligence and information warfare tools will provide quality data in a timely manner, and enable friendly commanders to operate inside of the enemy decision cycle. The objectives of these efforts are to gain information dominance, shape the battlefield and protect the force in accordance with concepts outlined for Force XXI intelligence operations.

FY 1998 Accomplishments:

- 3318
  - Developed laboratory exploitation techniques against wideband commercial communication signals used for military purposes.
  - Identified and developed command and control (C2) protect operational capabilities for deployed information systems and components.
  - Demonstrated laboratory exploitation capability against low power advanced communication system.
  - Developed breadboard of a field programmable gate array -based (FPGA) signal analysis/attack control system for potential IEWCS upgrade.
- 3828
  - Developed smart agent tools for effectively tasking and receiving multi-intelligence sensor data to support common ground station demonstration.
  - Developed advanced terrain reasoning tools, techniques, and signal intelligence (SIGINT) correlation, templating and associated terrain reasoning tools to enhance Common Ground Station (CGS) and All Source Analysis System (ASAS).
  - Established simulation project to assess incorporating information from airborne survivability equipment with conventional SIGINT assets.
  - Began prediction and assessment tools for electronic attack against modern communications signals.

Total 7146

FY 1999 Planned Program:

- 3309
  - Implement attack algorithms against modern communication and information systems, both military and commercial in a laboratory environment.
  - Demonstrate Electronic Support/Electronic Attack tactics techniques and procedures in controlled RF environment against a core signal set.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602270A Electronic Warfare (EW) Technology
	PROJECT: A906

– Develop countermeasure analysis tools focusing on network protection.

FY 1999 Planned Program (Continued):

- 3350 – Develop techniques to incorporate data from airborne survivability equipment and integrate into multi-sensor tasking and reporting tools.
  – Utilize COTS/GOTS software to enhance database storage and retrieval techniques.
  – Enhance SIGINT correlation, templating and associated terrain reasoning for visualization tools to enhance CGS and ASAS.
  – Develop tools to correlate intelligence data from tactical, other services and national assets to provide early entry ground force commander with multi-service data to increase survivability and lethality through enhanced battlefield awareness.
- 104 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 6763

FY 2000 Planned Program:

- 4019 – Modify existing testbed to emulate adversary digital communication networks, computer based networks and tactical information systems. Identify and assess the vulnerabilities and susceptibilities of RF and wired networked components.
  – Perform exploitation and attack strategies against the RF and wired network components in the enhanced testbed.
- 3873 – Develop enhanced intelligence collection, asset management tools and terrain reasoning tools to provide effective, user-friendly intelligence data dissemination techniques and battle damage assessment tools to enhance and protect the commander's decision and execution cycle.
  – Enhance technologies to integrate, disseminate and display intelligence data from tactical and national assets necessary to provide/enhance situational awareness of red forces at the brigade level.
  – Investigate neural network tools to optimize sensor arrays for sensor cross-cueing to provide the capability to intercept emitters 90% of time, given the emitter is within sensitivity range of two distributed sensors.

Total 7892

FY 2001 Planned Program:

- 4059 – Develop exploitation and attack capability against identified vulnerabilities and susceptibilities of adversaries' emerging communications networks and tactical information systems and computer based networks.
- – Develop methods, tactics, techniques and procedures to exploit emerging communication networks and tactical information systems and computer based networks with varying degrees of detectability to meet operational requirements.
- 4099 – Develop software products to integrate existing joint and national intelligence sensors, provide a common format for integration of sensor information, and provide a common situational awareness of red forces for the brigade commander.
  – Develop neural network tools to optimize sensor cross-cueing to provide the capability to intercept emitters 90% of time, given the emitter is within sensitivity range of two distributed sensors UAV linkage.
  – Identify technologies and techniques to provide next generation tools for intelligence preparation of the battlefield, asset management, and situational awareness of red and blue forces.

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602270A Electronic Warfare (EW) Technology**

Total 8158

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602303A Missile Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	22199	30130	32892	31469	29440	26045	27501	28859	Continuing	Continuing
A205 Solid State Dye Lasers	2810	0	0	0	0	0	0	0	0	6720
A214 Missile Technology	19389	30130	32892	31469	29440	26045	27501	28859	Continuing	Continuing

A. Mission Description and Budget Item Justification: This applied research program element is designed to provide the Army with missile, rocket, and unmanned vehicle technology for enhancement of existing assets. Its overall objective is to provide a continental U.S. (CONUS)-based Army with weapon systems enabling immediate world-wide deployment of forces with the capability to initially contain and ultimately achieve decisive victory against hostile forces equipped with modern weapons. The program element is driven by U. S. Army Training and Doctrine Command (TRADOC) Battle Labs and mission area analyses of deficiencies in the areas of close combat, fire support, air defense, intelligence/electronic warfare, and the priorities set forth in the Army Science and Technology Master Plan. The program element is focused on technologies which enhance weapon system deployability, flexibility, lethality, survivability, and affordability. Work within the program is conducted through system simulation, virtual prototyping, concept synthesis, hardware development, and focused technology demonstrations. The work in this program element is consistent with the resource constrained Army Science and Technology Master Plan, the Army Modernization Plan and the Defense Technology Area Plan. Work in this program element is related to and fully coordinated with efforts in PE 0602702E (Tactical Technology), PE 0602602F (Conventional Munitions), PE 0603601F (Conventional Weapons Technology), PE 0601104A (University and Industry Research Centers), PE 0603313A (Missile and Rocket Advanced Technology), PE 0603654A (LOSAT Advanced Concept Technology Demonstration), PE 0602782A (Command, Control and Communications (C3) Technology), PE 0605601A (Army Test Ranges and Facilities) in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	24238	25180	28460	26560
Appropriated Value	25335	30380		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1097	-250		
b. SBIR / STTR	-73			
c. Omnibus or Other Above Threshold Reductions	-24			
d. Below Threshold Reprogramming	-1942			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+4432	+4909
Current Budget Submit (FY 2000 PB)	22199	30130	32892	31469

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602303A Missile Technology**

Change Summary Explanation: FY 1999: Congressional increase of 5200.
FY 2000: Increase of 3374 for high performance, non-detonable, low signature insensitive propellant.
FY 2000: Increase of 1058 for demonstration of CKEM increased missile lethality and ballistic flight test.
FY 2001: Increase of 4909 for CKEM controlled flight tests and preparation of guided flight tests in FY02.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602303A Missile Technology

PROJECT: A205

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A205 Solid State Dye Lasers	2810	0	0	0	0	0	0	0	0	6720

Mission Description and Justification: Funds for this program were provided by Congress in FY 97 and FY 98. The effort is complete in FY98 and will require no additional funds. This program leverages technology developed under PE 0602307A/ Project A139 (Laser Technology). Project A205 provides for the development of dye laser technologies appropriate to future directed energy weapons, battlefield remote sensing, and the transfer of these technologies to medical applications. This project focuses on developing technologies related to the use of directed energy as a weapon against hardened targets, based on the fact that optical and radio frequency components are inherently vulnerable to laser radiation in their operating bands. This program is closely coordinated with the other services through the Joint Directors of Laboratories (JDL) Reliance Panel on Conventional Weapons. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command (AMCOM) Redstone Arsenal, AL. Major contractors include Textron Defense Systems (Wilmington, MA) and Physical Sciences Inc (Andover MA).

FY 1998 Accomplishments:

- 1096 - Completed the development and characterization of advanced solid host dye laser materials.
- 984 - Completed adaptation of zigzag resonator for use with solid dye laser gain media.
- 730 - Completed development and characterization of novel dye laser pump sources.

Total 2810

FY 1999 Planned Program: Program not funded in FY 1999.

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602303A Missile Technology

PROJECT: A214

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A214 Missile Technology	19389	30130	32892	31469	29440	26045	27501	28859	Continuing	Continuing

Mission Description and Justification: This project is focused on missile and rocket technologies that support high fire power/logistic support weight ratio concepts. Efforts address concepts that 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. This project encompasses seven major areas: missile guidance systems; air defense target acquisition systems; multi-spectral missile seekers; high fidelity system level simulations; missile aerodynamics and structure; smart, stealthy, smokeless missile propulsion; and focused technology integration/demonstrations. As efforts in these technology areas mature, work is transitioned to PE 0603313A (Missile and Rocket Advanced Technology) to support demonstrations of capabilities for Future Missile Technology Integration (FMTI), Low Cost Precision Kill for 2.75 inch rockets, and an advanced light weight hypervelocity missile. Technologies being developed focus on improvements to existing missile systems.

FY 1998 Accomplishments:

- 10276 - Missile guidance systems – Completed seeker design for High Quantities Anti-Materiel Submunition (HI-QUAMS) which provides a smaller seeker that will lead to a 5-10x improvement in stowed kills for Multiple Launch Rocket System/ Army Tactical Missile System (MLRS/ATACMS) when attacking lightly armored, high-value targets. Completed sensor requirements for detection, characterization, and/or identification of masked and concealed targets for Army missile cueing. Completed infrared (IR) polarimetry demonstrations. Developed fly-over-shoot-down imaging tracking algorithms.
  - High fidelity system level simulations - Completed a design for high-speed field programmable gate array circuits to achieve 10 Msamples/sec wideband digital quadrature modulator processing; developed and implemented codes and procedures to perform distributed XPATCH radio frequency signature code calculations; developed IR model validation; developed software for the control of programmable 'model board' IR and visual scene injection processors and interfaces, allowing the use of general purpose digital computers.
  - Missile aerodynamics and structure – Completed canard/grid fin roll control interaction wind tunnel test, completed elliptical body wind tunnel test, developed Chemically Reacting After Body (CRAFT) time-accurate, finite-volume, Navier-Stokes computational fluid dynamics model. Completed preliminary design and evaluated seeker dome for air and missile defense; demonstrated feasibility of composite airframes and structures.
- 9113 - Smart, stealthy, smokeless missile propulsion –Evaluated pintle materials and a high exponent propellant, and demonstrated multiple thrust levels; developed and evaluated minimum signatures solid propulsion propellants; developed advanced oxidizer fuel gels for long range, survivable, multi-mission capabilities which reduce assets required.
  - Focused technology integration/demonstrations - Developed a motor and propulsion concept of the compact kinetic energy missile (CKEM) technology; demonstrated necessary accuracy in hardware-in-the-loop (HWIL) simulation for a low cost accurate control package for the 2.75” rocket that will provide reduced cost per kill, minimized collateral damage and greatly increased number of stowed kills over the present fielded system. Completed and evaluated preliminary packaging/dispensing concept design for MLRS Smart Tactical Rocket (MSTAR).

Total 19389

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602303A Missile Technology
	PROJECT A214

FY 1999 Planned Program:

•	13187	- Missile guidance systems - Complete signature tests for difficult targets and masked helicopters, assess tracker, automatic target recognition, and non-cooperative target recognition on wide spectrum realistic data sets and targets which will develop acquisition technologies for defeating classes of targets which are currently difficult or impossible to defeat. - High fidelity system level simulations - Implement field programmable gate array processor-based digital quadrature modulators and verify 10 Msamples/sec processing performance; design Ka-band radio frequency (RF) front end processor (downconverter, intermediate frequency processor and analog-digital conversion) for the RF target verification monitor. Extend gray level co-occurrence matrices (GLCM) IR signature validation techniques to larger matrix sizes and increased number of gray scales. Investigate methods for parallel processing of segmented target image scenes on the programmable model board and address the resulting input/output issues. - Missile aerodynamics and structure – Evaluate MicroElectroMechanical Systems (MEMS) devices for lift enhancement; upgrade grid fin analytical model, investigate and model turbulent exhaust plume chemistry and solid carbon oxidation; complete final design, prototype fabrication, and ground testing of seeker dome for air and missile defense.
•	11157	- Smart, stealthy, smokeless missile propulsion – Demonstrate high performance, minimum signature solid propulsion, complete actuator and control integration and complete axial pintle component design; develop gel flightweight component for long range, survivable, multi-mission capabilities which reduce assets required; demonstrate proof of concept of accurate age assessment through non-destructive evaluation to field aged samples for service life extension. - Focused technology integration/demonstrations – Demonstrate/validate flightweight compact hypervelocity missile technology propulsion concepts for CKEM which will provide an overmatch capability against all tanks and armored targets; wind tunnel test and transition Low Cost Precision Kill (LCPK) to PE0603313A, which will provide reduced cost per kill, minimized collateral damage and greatly increased number of stowed kills over the present fielded system stable airframe.
•	1450	- Acoustic methods will be evaluated for applicability to enhanced mixing concepts for propulsion for Army missile systems.
•	1933	- Evaluate Scramjet hardware and develop a combustor concept for M > 10 operation.
•	1934	- Upgrade APS radar testbed, for CAPS testing, to represent new threat capabilities; design munitions test bed; and design and fabricate salvage sensor breadboards.
•	469	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	30130	

FY 2000 Planned Program:

•	14567	Missile guidance systems – Integrate and test HI-QUAMS seeker brassboard which provides a smaller seeker that will lead to a 5-10x improvement in stowed kills for MLRS/ATACMS when attacking lightly armored, highly-valued targets; develop jamming/spoofing models needed to develop anti-jamming/spoofing technology small enough and affordable for Army tactical missiles; complete baseline design for a HMMWV-based SHORAD sensor system for air defense firecontrol/missile guidance radar.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602303A Missile Technology	PROJECT A214

FY 2000 Planned Program: (continued)

- High fidelity system level simulations - Extend the field programmable gate array digital quadrature modulator for increased processor throughput and higher clock rates; investigate Doppler phase shift effects on RF signatures during signal integration times and develop phase coherent signal processing techniques for frequency modulated and frequency stepped RF guidance signals; extend the Ka-band radio frequency (RF) front-end processor design of the RF target verification monitor to handle extremely short RF pulses; implement parallel processing programmable model board software for real-time, dynamic representation of missile seeker input optics and target image sensed scene irregularities.
- Missile aerodynamics and structure - Design the Container Launched Attack Weapon System (CLAWS) launch orientation module hardware and software that will provide an order of magnitude increase in firepower for selected situations; perform imaging demonstration for a seeker dome with conformal optics for air and missile defense that will provide the technology to extend the range for Stinger Block II.

• 18325 - Smart, stealthy, smokeless missile propulsion – Complete development of improved fuel gel for long range, survivable, multi-mission capabilities which reduce assets required; develop hydrogen chloride (HCl)-free propellants, and a small scale motor testing of ADN propellants for minimum signature propulsion.
- Focused technology integration/demonstrations – Demonstrate 25% increase in missile lethality and conduct a ballistic flight test to demonstrate packing of a reduced size/mass CKEM which will provide an overmatch capability against all tanks and armored targets; develop control and datalink for Remote Readiness Asset Prognostics/Diagnostics System (RRAPDS) which provides near real-time logistics situational awareness thereby significantly reducing operating and support costs.

Total 32892

FY 2001 Planned Program

• 12426 Missile guidance systems –Package the HI-QUAMS seeker that will lead to a 5-10x improvement in stowed kills for MLRS/ATACMS when attacking lightly armored, highly-valued targets; integrate inertial instruments in a laboratory brassboard MEMS based Inertial Measurement Unit (IMU) which will lead to an low cost IMU with common features for use in multiple weapon systems;
- High fidelity system level simulations – Investigate IR target signature modeling approaches applicable to active IR target acquisition and track sensors; develop methods and software for representing 3-dimensional target geometry models applicable to active IR sensors where signal polarization may be a processing discriminant; investigate methods of projecting HWIL in-band IR target images and scenes with adequate scene detail and dynamic range to include the effects of active and passive IR countermeasures.
- Missile aerodynamics and structure –Build and test the CLAWS launch orientation module hardware and software that will provide an order of magnitude increase in firepower for selected situations; complete a time-accurate vehicle/nozzle/plume computational fluid dynamics model which will aid in the design of missile structures.

• 19043 - Smart, stealthy, smokeless missile propulsion –Complete component development of flight type hardware integrate into a brassboard and test a flexible sustainer for long range, survivable, multi-mission capabilities which reduce assets required; complete vacuum aging study for service life prediction for cost avoidance of replacing propulsion systems and increased system safety and performance reliability.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602303A Missile Technology
	PROJECT A214

FY 2001 Planned Program: (Continued)

- Focused technology integration/demonstrations –Complete first generation system integration of RRAPDS which provides near real-time logistics situational awareness thereby significantly reducing operating and support costs; demonstrate airframe integrity, verify guidance communications and characterize launch environment, perform controlled flight tests and prepare for guided flight tests (early FY02) of CKEM; complete design of a miniature aerial vehicle to provide real-time targeting for short/medium range indirect fire munitions.

Total 31469

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602308A Advanced Concepts and Simulations

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	19660	21494	24955	24799	25007	38546	44020	48975	Continuing	Continuing
AC90 Advanced Distributed Simulation	9341	8407	10291	10495	10545	10714	12079	12683	Continuing	Continuing
AC99 Advanced Concepts & Technology	10319	10603	14664	14304	14462	14453	17694	20609	Continuing	Continuing
AD01 Photonics Research	0	2484	0	0	0	0	0	0	0	2484
A636 Army After Next Applied Research	0	0	0	0	0	13379	14247	15683	Continuing	Continuing

A. Mission Description and Budget Item Justification: Work in this program element (PE) advances development and use of modeling and simulation, including Advanced Distributed Simulation (ADS), related to Army-specific experiments/demonstrations and industry participation at the U. S. Army Training and Doctrine Command (TRADOC) Battle Labs, Army's Force XXI, and Army After Next experiments. It develops standards, architecture and interfaces essential to realizing the DoD/Army vision of creating a verified, validated and accredited synthetic "electronic battlefield" environment. The electronic battlefield is used to investigate and demonstrate new warfighting concepts including development of tactics, doctrine, training techniques, soldier support, systems and system upgrades. It directs and stimulates advances in those technologies required for real time interactive linking within and among constructive, virtual and live simulation.

Simulation Training and Instrumentation Command (STRICOM) located at Orlando, FL is responsible for Project AC90. Work is performed by the broadest range of the nation's industrial and academic communities. Contractors include: Natural Selection, La Jolla, CA; Acusoft, Orlando, FL; Pathfinder Systems, Lakewood, CO; SAIC, San Diego, CA; University of Central Florida, Institute for Simulation and Training, Orlando, FL; Veda Incorporated, Orlando, FL; Perceptronics, Inc., Woodland Hills, CA; Lockheed Martin, Orlando, FL.

The Army Research Office-Washington, Alexandria, VA is responsible for Project AC99. Work is performed by the broadest range of the nation's industrial and academic communities. This project supports the Advanced Concepts and Technology (ACT) II Program. ACT II uses a yearly Broad Agency Announcement (BAA) to industry and academia, and provides a low overhead, timely mechanism for the demonstration of mature, commercial off-the-shelf (COTS) technologies, prototypes, software, and /or systems for assessment by the TRADOC Battle Labs. Contractors include contractors: Center for Photonics Research, Boston, MA; Chain Reactions, Gold River, CA; FFE International, Alexandria, VA; Harris Corporation, Rochester NY; Hughes, Tucson, AZ; Lockheed Martin, Pomona, CA; Lockheed Martin, Dallas, TX; Lucent Technologies, McLeansville, NC, Boeing, Huntington Beach, CA; McDonnell Douglas, Huntsville, AL; Mobile Datacom, Clarksburg, MD; Monterey Bay, Columbia, MD; Morris Brown College, Atlanta, GA; Mystech Associates, Falls Church, VA; Northrop Grumman, Baltimore, MD; Research Triangle Institute, Research Triangle Park, NC; Rolands & Associates, Monterey, CA; Syracuse Research, Syracuse, NY.

The Photonics Research project funds research conducted at the Boston University Photonics Center. This project is a Congressional add in FY 1999.

Future efforts for these projects will be performed by a broad range of contractors selected in response to the Broad Agency Announcement (BAA) process. These programs are fully coordinated with the other Army applied research exploratory development programs, Defense Advanced Research Projects Agency (DARPA), Defense Modeling and Simulation Office, TRADOC and DoD Project Reliance agreements on conventional air/surface weaponry, with oversight provided by the Joint Directors of

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602308A Advanced Concepts and Simulations**

Laboratories. Work in these projects are related to and fully coordinated with efforts in PE 0604715A (Non-System Training Devices - Engineering Development). There is no duplication of effort within the Army or Department of Defense.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	20339	27981	31552	34427
Appropriated Value	21059	21653		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-720	-159		
b. SBIR / STTR	-511			
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions	-168			
Adjustments to Budget Years Since FY 1999 PB			-6597	-9628
Current Budget Submit (FY 2000 / 2001 PB)	19660	21494	24955	24799

Change Summary Explanation: Funding – FY 1999 – Congressional reduction to PE (-6328).
FY 2000/2001 – Funds reprogrammed to higher priority requirements.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602308A Advanced Concepts and Simulations

PROJECT: AC90

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AC90 Advanced Distributed Simulation	9341	8407	10291	10495	10545	10714	12079	12683	Continuing	Continuing

Mission Description and Justification: This program provides and demonstrates enabling technologies for advancing Distributed Interactive Simulation (DIS) in the synthetic environment and the representation of the battlefield needed to support the use of modeling and simulation as an acquisition tool and training in the era of reduced funding. Efforts in this project support the Battlefield Distributed Simulation-Developmental (BDS-D) program. BDS-D will provide virtual representation of a lethal combined arms environment with the warfighter-in-the-loop that closed-form analysis cannot provide. The environment permits new system concepts, tactics and doctrine and test requirements to be evaluated with a warfighter-in-the-loop in a combined arms battlefield throughout the acquisition life cycle at a reduced cost and time compared to the traditional approach. The research being conducted includes Semi-Automated Forces (SAF), simulation interface and linkage technologies, and complex data modeling and interchange.

FY 1998 Accomplishments:

- 791 Performed experimentation to assess scalability limitations inherent in current and next generation architectures; expanded non-rule based intelligent behavioral capability to take into account capabilities, constraints, and purpose.
- 1400 Provided and demonstrated the capability to fully immerse the live individual combatant in the synthetic environment, to include control of Semi-Automated Forces (SAF) through voice and gesture recognition. Developed an improved dismounted infantry SAF, to include Military Operations in Urban Terrain (MOUT) behaviors.
- 2500 Developed and prototyped Embedded Simulation (ES) modular hardware and software common components. Prototyped virtual-live interactive system. Linked STRICOM ES test bed with TACOM VETRONICS Systems Integration Laboratory (VSIL) and CECOM Digital Integrated Lab (DIL).
- 4650 Developed and enhanced the synthetic environment to support a corps-sized battlefield. Developed and evaluated open object-oriented architecture, including methods for model definition and VV&A of networked simulations. Continued standards development/testing, expanded terrain data base work, and evolved/refined data collection and analysis.

Total 9341

FY 1999 Planned Program:

- 849 Address CGF (Computer Generated Forces) system architectural composability. Demonstrate advanced behavioral technology.
- 2500 Tailor and integrate standard ES components to Future Scout and Cavalry System (FSCS) ATD program. With TRADOC, develop prototype training scenarios and databases.
- 3132 Develop and enhance the synthetic environment to support an Echelon Above Corps (EAC) sized battlefield. Develop and evaluate open object-oriented architecture, including methods for model definition and VV&A of networked simulations.
- 925 Develop the Advanced Tactical Engagement Simulations (A-TES) framework with virtual integration capability and authoritative information center.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602308A Advanced Concepts and Simulations
	PROJECT AC90

FY 1999 Planned Program: (continued)

•	800	Develop a prototype capability for individual and small unit synthetic forces that represent doctrinally correct Army behaviors.
	201	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	8407	

FY 2000 Planned Program:

•	980	Implement the Advanced Tactical Engagement Simulations (A-TES) framework with simulation-intensive R&D of soldier-fired indirect fire weapons.
•	2500	Support TARDEC with in-vehicle High Level Architecture (HLA) experiments using Vehicle Electronics Suite.
•	846	Develop intelligent behavioral implementations and demonstrate significantly increased capabilities for scaleable and configurable CGF representation.
•	5165	Demonstrate common tools and capabilities for High Level Architecture (HLA) and Synthetic Environment (SE).
•	800	Develop prototype dismounted soldier virtual environment night vision/sensor capability.
Total	10291	

FY 2001 Planned Program:

•	980	Enhance the Advanced Tactical Engagement Simulations (A-TES) virtual integration testbed with hybrid simulation and hardware-in-the-loop experiments.
•	2500	Demonstrate an Embedded Simulation System (ESS) using a brass board vehicle surrogate at the National Training Center.
•	870	Study intelligent behavioral approaches. Demonstrate prototype capabilities and address technology transfer and implementation issues.
•	5245	Demonstrate common tools and capabilities for High Level Architecture (HLA) and Synthetic Environment (SE).
•	900	Develop prototype dismounted soldier virtual environment gesture recognition system. Evaluate effectiveness of night operations simulation.
Total	10495	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602308A Advanced Concepts and Simulations PROJECT AC99

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AC99 Advanced Concepts & Technology	10319	10603	14664	14304	14462	14453	17694	20609	Continuing	Continuing

Mission Description and Justification: This project supports the Advanced Concepts and Technology (ACT) II Program. It evaluates new concepts through soldier in the loop, constructive and virtual simulations electronic battlefield demonstrations and field tests, and modeling and simulations in real time. Specific areas of interest include: battlespace management and battlefield synchronization, depth and attack operations, lethality, survivability and mobility; command, control, communications, and computers (to include interoperability); force sustainment; and doctrine and leader development. All projects support and complement the Army computer technical architecture tenets. The Act II goal is to advance a need from concept to demonstration to the soldier in one year. ACT II uses a yearly Broad Agency Announcement (BAA) to industry and academia, and provides a low overhead, timely mechanism for the demonstration of mature, commercial off-the-shelf (COTS) technologies, prototypes, software, and /or systems for assessment by the TRADOC Battle Labs.

FY 1998 Accomplishments:

- 10319 Conducted demonstrations and experiments in support of the Army Training and Doctrine Command's Battle Labs:
  (1) In response to the Broad Agency Announcement to industry and academia, and after a very competitive selection process, awarded 19 ACT II projects from fourteen states. These projects demonstrated the highest potential to enhance warfighter capabilities.
  (2) Projects included enhanced combat identification, tele-maintenance, force protection, communications, and logistics tracking initiatives. Industry/academia participants include Northrop Grumman, California; Boston University, Massachusetts; Microvision, Washington; Oshkosh Trucks, Wisconsin; Research Triangle Institute, North Carolina; Kaiser Electronics, California; ITT Aerospace, Indiana; and Optimetrics Inc., Maryland.
  (3) Analyzed and evaluated the results of FY 1997 efforts; identifying candidates for streamlined acquisitions or follow-on test and evaluation.
  (4) Continually upgraded management controls with the goal of identifying further efficiencies in the process.

Total 10319

FY 1999 Planned Program:

- 10322 Conduct demonstrations and experiments in support of Battle Labs.
  This effort includes the following activities:
  (1) Supervise, integrate, and approve the Broad Area Announcement (BAA) Topics for new ACT II projects. Ensure that these topics facilitate proposals which meet the criteria of the program: mature, COTS technology which addresses specific warfighter requirements. Ensure widest dissemination of the BAA throughout the industrial and academic communities.
  (2) Selected proposals which were technically feasible, offered the best potential return on investment, and fulfilled a specific Army requirement. Projects included less-than-lethal munitions for peace keeping operations, advanced communications prototype, night vision system, integrated command bridge system, and advanced computing capabilities. Industry/academia participants include Colt Manufacturing, Connecticut; Northwestern University, Illinois; CANVAS Corp., Florida; Sperry Marine Inc., Virginia; Boeing/McDonnell Douglas Corp.; and Litton Systems Inc., California.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602308A Advanced Concepts and Simulations
	PROJECT AC99

FY 1999 Planned Program: (continued)

(3) Analyze and evaluate FY98 projects for follow-on test and evaluation.
(4) Continue to streamline management controls for efficiencies in the process.

- 281 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 10603

FY 2000 Planned Program:

- 14664 Conduct demonstrations and experiments in support of Battle Labs.
  This effort includes the following activities:
  (1) Release BAA to solicit Battle Lab related concepts and technologies from the nation's industrial and academic communities.
  (2) Select, within resource constraints, high payoff and innovative efforts for demonstration of warfighting capabilities.
  (3) Analyze and evaluate the results of FY 1999 efforts; identifying candidates for streamlined acquisitions.
  (4) Approve BAA topics for new ACT II projects to satisfy future Army and DoD needs not being addressed by existing programs.

Total 14664

FY 2001 Planned Program:

- 14304 Conduct demonstrations and experiments in support of Battle Labs.
  This effort includes the following activities:
  (1) Release BAA to solicit Battle Lab related concepts and technologies from the nation's industrial and academic communities.
  (2) Select, within resource constraints, high payoff and innovative efforts for demonstration of warfighter capabilities.
  (3) Analyze and evaluate the results of FY 2000 efforts; identifying candidates for streamlined acquisitions.
  (4) Approve BAA topics for new ACT II projects to satisfy future Army and DoD need not being addressed by existing programs.

Total 14304

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602308A Advanced Concepts and Simulations

PROJECT: AD01

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AD01 Photonics Research	0	2484	0	0	0	0	0	0	0	2484

Mission Description and Justification: This Congressional add project supports photonics research at the Boston University Photonics Center for Army smart imaging and communications applications. Key areas include magnetic and optical devices, silicon micromechanical optical components, and bio-photonic materials. Development of these materials and technologies, which have application in communications, data modulation, optoelectronics, and optical control of microwaves, will be leveraged with commercial developments and, as a consequence, drive the costs for components and devices lower. Significant Army applications include technology for night vision and imaging equipment and devices to enable communications while on-the-move.

FY 1998 Accomplishments: Program not funded in FY 1998.

FY 1999 Planned Program:

- 2418 Conduct research in magnetic and optical devices, silicon micromechanical optical components, and bio-photonic materials at the Boston University Photonics Center.
- 66 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2484

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: **February 1999**

BUDGET ACTIVITY: **2 - Applied Research**

PE NUMBER AND TITLE: **0602601A Combat Vehicle and Automotive Technology**

	COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	62141	39208	39749	41625	43743	45771	50679	53313	Continuing	Continuing
DC05	Armor Exploratory Development	6176	6650	8453	9026	9004	9716	10452	11069	Continuing	Continuing
DC84	AC84	1879	461	0	0	984	984	1965	2943	Continuing	Continuing
AH39	Voice Instructional Device	2810	0	0	0	0	0	0	0	0	2810
AH58	Joint Robotic Development Program on Ground Vehicle Survivability	4216	2980	0	0	0	0	0	0	0	7216
AH72	ADAD on Bradley Stinger Fighting Vehicle	3747	0	0	0	0	0	0	0	0	3747
AH77	Advanced Automotive Technology	22702	18653	16646	16664	16593	16614	16888	16909	Continuing	Continuing
AH82	Non-Ozone Depleting Substance Technology	2273	1342	0	0	0	0	0	0	0	3627
AH91	Tank and Automotive Technology	12717	9122	14650	15935	17162	18457	21374	22392	Continuing	Continuing
BH74	Simulation Laboratory	5621	0	0	0	0	0	0	0	0	5621

A. Mission Description and Budget Item Justification: This Program Element (PE) advances technologies for affordable and effective ground combat and tactical vehicles. Emphasis is placed on technologies needed for vehicles that are more mobile, affordable, versatile and highly survivable for the post Cold War era. New technologies are needed to achieve more deployable advanced armored vehicles that reflect the Army's need to lighten the force while retaining the ability to survive in diverse, worldwide environments and missions. The majority of the funds in this PE are contained in three projects, AH91, which supports a number of technical thrusts aimed at solving warfighting needs; DC05, which addresses armor technology; and AH77, which funds the National Automotive Center (NAC). The NAC leverages commercial industry's large investment in automotive technology research and development and pursues shared technology programs that are focused on benefiting military ground vehicles. The NAC manages the U.S. Army Tank-Automotive Research, Development and Engineering Center's (TARDEC) Small Business Innovation Research (SBIR) budget and executes selected SBIR projects. The NAC also is a principal Army conduit for DoD Dual Use Application Program and has leveraged over $50M of industry funding. This PE also supports efforts to identify and evaluate non-ozone depleting fire suppressant alternatives to Halon 1301 for combat vehicles.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology**

Work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Ground and Sea Vehicle Defense Technology Area Plan

(DTAP). The PE is managed by the TARDEC, Warren, MI. This program 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. There is no unnecessary duplication of effort within the Army or DoD. The project is coordinated with the Marine Corps office within the Naval Surface Warfare Center and ground vehicle developers within the Departments of Energy, Commerce and Transportation, and the Defense Advanced Research Projects Agency (DARPA).

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	60162	40107	35403	35639
Appropriated Value	62112	39562		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1950	-354		
b. SBIR / STTR	-1172			
c. Omnibus or Other Above Threshold Reductions	-386			
d. Below Threshold Reprogramming	+3537			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+4346	+5986
Current Budget Submit (FY 2000 / 2001 PB)	62141	39208	39749	41625

Change Summary Explanation: Funding - FY 2000 – Increase reflects restructure of funding for proper execution of armor/anti-armor technology programs (+2971) and restructured funding for international cooperative R&D programs in the combat vehicle and automotive technology area (+1375).

FY 2001 – Increase reflects restructure of funding for proper execution of armor/anti-armor technology programs (+3707), restructured funding for international cooperative R&D programs in the combat vehicle and automotive technology area (+1279), and increase for wheeled combat vehicles (+1000).

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

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

PROJECT: DC05

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DC05 Armor Exploratory Development	6176	6650	8453	9026	9004	9716	10452	11069	Continuing	Continuing

Mission Description and Justification: This project lays the technical foundation to solve critical armor deficiencies and improve the survivability of ground combat vehicles against increasingly lethal anti-armor weapons and mines. Supporting the ultimate objective of lighter, more deployable, more survivable vehicles, the emphasis is on armor technologies that will be compatible with current and emerging combat systems (e.g., Abrams, Bradley, Crusader, Future Scout and Cavalry System). The project also develops low-burden solutions to the protection of tactical vehicles in war and operations other than war focusing on appliqué armor for small arms and land mine protection. Armors developed under this project have been applied to tactical vehicles, and this type of technology can be directly attributed to saving lives of U.S. Army soldiers in Bosnia. This project develops armor technologies to complement innovative non-armor survivability techniques such as laser protection described in project AH91 in this PE. Within the broader field of armor development, this project focuses technology on the weight, space, performance, and cost ranges appropriate to ground combat systems: protection of combat and tactical vehicles against such threats as kinetic energy projectiles, explosively formed penetrators, chemical energy warheads, and blast and fragments from land mines. This project draws upon products from Army Research Laboratory programs (e.g., PE 0602618A (Ballistic Technology) project AH80 and PE 0602105 (Materials) project AH84 as well as innovative armors from industry, facilitating the application of armor products from those programs to Army systems. Starting in FY00, Project H81 in PE 0602618A was terminated and funds were transferred from that project to DC05 to better focus armor research. The consolidation of funds from project AH81 into DC05 explains funding growth from FY99 to FY00. In addition to development of specific armor concepts, the project includes supporting work in armor materials, bringing together the collective expertise of the Department of Defense, the Department of Energy, and industrial and academic sources. Supporting work also includes development and refinement of armor performance models to assess armor configurations against different threats with sufficiently high fidelity to make their implementation in vehicles feasible and affordable. Other government agencies include: Jet Propulsion Lab, Pasadena, CA; National Institute of Standards and Technology (NIST), Gaithersburg, MD.

FY 1998 Accomplishments:

- 2126 - Developed hybrid reactive armor concept for light weight future combat vehicle systems.
  - Demonstrated light weight flank ballistic protective systems for scout class vehicles.
  - Demonstrated an advanced overhead protection technology integrating threat defeat with combat vehicle requirements for vision systems and vehicle hatches.
- 1900 - Developed medium caliber kinetic energy (KE) defeat system and structures for protection for medium and heavy class combat vehicles.
  - Developed improved smart armor KE threat defeat sensor to support technology selection for future combat systems.
- 1100 - Developed and validated analytical methods for design of ceramic armors with maximum energy dissipation for defeat of KE threats.
  - Validated armor penetration mechanics model augmented to include energetic armor effects to shorten design cycle and reduce test costs.
- 1050 - Conducted component demonstrations on a tactical wheeled vehicle to include advanced mine protection.

Total 6176

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A Combat Vehicle and Automotive Technology
	PROJECT DC05

FY 1999 Planned Program:

•	1600	- Demonstrate smart armor package defeating KE threats with 35% weight saving, providing the technological basis for protection of lighter vehicles against medium caliber automatic cannon-fired penetrators.
•	1307	- Create an armor virtual prototyping system which will use modeling and simulation to shorten the design cycle and reduce the development cost of future vehicles and of armor upgrades to existing vehicles. - Validate methods for ceramic armor design using analytical models to extend the capabilities of the virtual prototyping system. - Demonstrate 25% reduction in typical test cost for armor design through use of the virtual prototyping system.
•	1050	- Complete assessment of electrodynamic armor defeat mechanisms which may offer significant operational benefits for combat vehicles.
•	950	- Demonstrate combined armor/signature control configurations.
•	1600	- Complete fabrication and demonstration of a prototype wheeled vehicle module for the protected transport of troops in an environment of small arms and mine threats such as was the case in Bosnia and Somalia. - Complete and test survivability appliqués for tactical vehicles.
•	143	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	6650	

FY 2000 Planned Program:

•	1400	- Develop armors for medium caliber KE threats that are 50% more space efficient than the 1996 state of the art, making possible more compact and deployable combat vehicles.
•	1500	- Define and develop lightweight armor systems against a spectrum of threats faced by vehicles in the 18-40 ton weight range.
•	1200	- Characterize the debris produced by KE and chemical energy (CE) threats which have been disrupted by prototype Active Protection Systems (APS), to provide the foundation for the lightweight armors that will complement APS to protect combat vehicles.
•	1000	- Define, through simulation and component test, the structural and material requirements for integrated multifunctional armor/structure systems that will dramatically reduce the weight of combat systems.
•	1500	- Integrate armor configurations from 0602618A/AH80 and material and structure technology from 0602105A/AH84 into multiple armor/structure systems for demonstration in FY 2001.
•	1478	- Complete a second generation suite of kit components for increasing the survivability of tactical wheeled vehicle occupants against the small arms and mine threats.
•	375	- In partnership with United Kingdom (UK), develop a set of design tools to investigate unique electro-dynamic defeat of anti-armor threats technology constructs for combat vehicle upgrades and concepts.
Total	8453	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology**
	PROJECT **DC05**

FY 2001 Planned Program:

•	2039	- Demonstrate armor systems with 30% greater weight efficiency than the 1996 state of the art against horizontal KE and CE threats, and the capability back up an APS; these armor systems will provide vehicles in the 18-40 ton range with the survivability required by the future battlefield.
•	2000	- Develop and demonstrate top attack armor systems to complement future APS with 30% greater weight efficiency than the 1996 state of the art.
•	2200	- Demonstrate a series of integrated multifunctional armor/structure systems against the heavy machine gun threat that will offer 25% improved weight efficiency over the Composite Armored Vehicle (CAV), at a projected production cost less that 1.5 times that of the CAV, providing improved survivability at an affordable cost.
•	2408	- Develop armor/structure systems with 30% improved efficiency against medium caliber KE and CE threats for demonstration in FY02.
•	379	- In partnership with UK, develop a set of design tools to investigate unique electro dynamic defeat of anti-armor threats technology constructs for combat vehicle upgrades and concepts.
Total	9026	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology** PROJECT **AH39**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH39 Voice Instructional Device	2810	0	0	0	0	0	0	0	0	2810

Mission Description and Justification: This Congressionally directed program, managed by the National Automotive Center, funded the design, development and testing of a Voice Instructional Device (VID) for use with fuel tankers, the Palletized Loading System and M1022A1 Dolly Wheeled Hydraulic System. VID is an audio device that can be used by maintenance personnel to perform inspection or hands free repair procedures.

FY 1998 Accomplishments:

- 2810 - Completed the FY 97-funded concept exploration and requirements survey effort with updated prototype VID sets and selected field demonstrations.

Total 2810

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

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

PROJECT: AH58

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH58 Joint Robotic Development Program on Ground Vehicle Survivability	4216	2980	0	0	0	0	0	0	0	7216

Mission Description and Justification This Congressionally directed project develops and demonstrates components for robotic and semi-robotic military vehicles which are not specific to any single system. This project integrates vehicle survivability, mobility, intra-vehicular digital electronics, and integration of diverse vehicle technologies developed by the Army, other DoD laboratories and industry. It focuses on two critical areas of deficient performance in robotic and semi-robotic vehicles: mobility and navigation. High priority components are (1) "smart" running gear (e.g., integral in-hub electric drive, tire inflation control, active shock absorption, etc., and sensors for motor torque, wheel velocity, etc.), (2) semi-autonomous navigation (e.g., machine perception hardware and software for terrain characterization, obstacle detection and crossing or avoidance, path selection, and remote operator interface). Improved survivability is a natural by-product of removing the crew from the vehicle which greatly removes the need for armor, and reduces vehicle size to present a smaller target. Robotics has payoffs for manual systems as well by reducing crew workload. Work on this project is consistent with and fills a gap in the Joint Service Unmanned Ground Vehicle Master Plan. The project will also develop a Systems Integration Laboratory (SIL) to assess the compatibility of robotic/semi-autonomous vehicle locomotion and navigation sub-systems, to assess net vehicle performance, to design interfaces, and to optimize/harmonize the performance and characteristics of the subsystems. FY98 Intelligent Mobility Robotics contracts were awarded to Utah State University, Logan, UT; General Dynamics Land Systems, Muskegon, MI; Turing Associates, Ann Arbor, MI; and Tennessee State University, Nashville, TN. This project will be completed in FY99.

FY 1998 Accomplishments:

- 2143
  - Developed a modular "smart" running gear and demonstrated smart running gear unit scaled for a 2,500 lb. vehicle.
  - Tested and evaluated multi-wheel central command , control and coordination.
  - Optimized modular electric motor power, size and efficiency.
  - Developed alternative power efficient distribution systems.
- 2073
  - Completed final demonstration and simulation of full scale components.
  - Completed design of a 4,300 square feet Systems Integration Laboratory (SIL) which will house a Modeling & Simulation Lab, a Hot Bench and Test Integration Room, and a Supervised Navigation Test Area. The SIL will be constructed at US Army TACOM-TARDEC in FY99.
  - Completed development of instrumentation for a reconfigurable remote vehicle operator station for modular robotic technology platforms.
  - Supported the OSD funded Joint Robotics Program (JRP) Demo III unmanned ground vehicle demonstration.

Total 4216

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology** PROJECT **AH58**

FY 1999 Planned Program:

•	2604	- Upgrade contractor's 100lb. robotic vehicle to include z-axis omni-directional steering capability for complete 6-degree of freedom electric wheel control. - Improve contractor's existing 1000 lb. robotic vehicle intelligent path planning and control algorithms conditions. - Demonstrate scalability of both (100 lb. and 1000 lb.) weight class UGVs to Demo III and man-portable robot applications and follow-on programs. - Complete construction of the robotic vehicle SIL for technology test and evaluation.
•	298	- Participate in Simulation Based Acquisition demonstration for the Total Life Cycle (SIM-TLC).
•	78	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	2980	

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

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

PROJECT: AH72

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH72 ADAD on Bradley Stinger Fighting Vehicle	3747	0	0	0	0	0	0	0	0	3747

Mission Description and Justification: This Congressionally directed program funds investigation into and demonstration of one or more air defense alerting devices applicable to Bradley Stinger air defense vehicles, Avenger, Linebacker and Light Armored Vehicle-Air Defense.

FY 1998 Accomplishments:

- 1670 - Purchased ADAD system and contracted system technical support.
- 1000 - Designed ADAD interface with Bradley Linebacker system and performed integration into a test bed.
- 1077 - Designed instrumentation for laboratory and initiated field testing to ADAD at White Sands Missile Range.

Total 3747

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A Combat Vehicle and Automotive Technology PROJECT AH77

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH77 Advanced Automotive Technology	22702	18653	16646	16664	16593	16614	16888	16909	Continuing	Continuing

Mission Description and Justification: This project funds the National Automotive Center (NAC), which leverages commercial industry's large investment in automotive technology research and development and initiates shared technology programs that are focused on benefiting military ground vehicle systems. The NAC, located at the Tank-Automotive and Armaments Command (TACOM), is part of the Tank-Automotive Research, Development and Engineering Center (TARDEC). The NAC serves as the catalyst linking industry, academia and government agencies for the development and exchange of automotive technologies. The NAC executes collaborative research and development (R&D) contracts, cooperative agreements, and other initiatives to leverage commercial industry's investment in well-defined, high return-on-investment areas tied to key Army science and technology objectives for advanced land combat. The NAC focuses collaborative R&D contracts on key military automotive technology thrust areas to include: mobility, electronics, propulsion, logistics, safety and environmental protection with the goal of (a) improving the performance and endurance of ground vehicle fleets, and (b) reducing ground vehicle design, manufacturing, production, and operating and support costs. Two-way industry/government technology transfer is pursued under Cooperative Research and Development Agreements (CRADAs). The NAC also leverages DoD Dual-Use Application Program (DUAP) resources. Industry joint investment under the NAC DUAP programs exceeds $50M. The activities of the NAC are supported by other government agencies via a linkage created under Memoranda of Agreement, and oversight is provided by a Senior Advisory Board which includes representation from appropriate program executive offices and program managers, the User, the Army staff, the U.S. Marine Corps and OSD. These linkages permit the NAC to consolidate the collective expertise of federal government departments such as Energy, Transportation and Commerce and other DoD agencies. The NAC performs basic research in PE 0601104A, project BH73 (NAC). The NAC also manages the TARDEC Small Business Innovation Research (SBIR) budget, and executes selected SBIR projects. Major contractors include: ARCCA, Inc.; Penns Park PA; FOCUS: Hope, Detroit, MI; Polymer research Corporation, Brooklyn, NY; University of Texas, Austin, TX; Environmental Institute of Michigan, Ann Arbor, MI; Oshkosh Truck Corporation, Oshkosh, WI; Lockheed Martin Inc., Lexington, MA; Rocky Research Inc., Boulder City, NV; USCAR-PNVG/Ford, Dearborn, MI; Cummins Engine Company, Columbus, IN; ICRC Energy Inc., Oakton, VA; Radian, Inc., Alexandria, VA; Baum, Romstedt Technology Research Corp. (BRTRC Inc.), Fairfax, VA; TASC. Inc, Reading, MA; Southwest Research Institute, San Antonio, TX; Hughes Aircraft, Arlington, TX; Electronic Data Systems, Troy, MI; University of Wisconsin, Madison, WI; University of Iowa, Iowa City, IA; Evans and Southerland Inc., Salt Lake City, UT; AB Technologies, Alexandria, VA; Lockheed Martin Control Systems, Johnson City, N.Y.

FY 1998 Accomplishments:

- 7241 - Developed and demonstrated advanced commercial automotive technologies to include: adaptive cruise control; anti-lock braking; active suspension; protective coatings; composite trailer decking; virtual product development enhancements; driver/vehicle interface; micro-auxiliary power units; integrated seat design; tire monitoring; and ceramic coatings for engine components.
  - Provided $2M in FY98 funds in the Metal Matrix Composites program to match the $2M in funding provided in Title III funding.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology**
	PROJECT **AH77**

FY 1998 Accomplishments: (continued)

- 3474 - Designed and developed automotive technologies under Dual-Use Application Program (DUAP); projects included: next-generation light truck; smart diagnostics and repair; heavy truck powerpack enhancements; active braking; low-cost infrared imaging sensors; fuel-fired heating, ventilation, air conditioning; advanced fuel injection; recycled polymer and synthetic component materials processing; alloy engine mono-block; lightweight diesel engine; optimized motor and controller; soft-switching inverters; enhanced crash protection.
- 1204 - Completed Congressional directed add to increase rated horsepower of a MACK E9 diesel engine by 50%, from 500 HP to 750 HP, while controlling emissions; integrated the engine into a Palletized Loading System (PLS) truck for in-vehicle demonstrations.
- 4816 - Completed Congressional directed add to investigate integration of advanced commercial technologies into the remanufacture of the 6.2 liter High Mobility Multipurpose Wheeled Vehicle (HMMWV) diesel engine to reduce dependence on obsolete commercial components, increased use of off-the-shelf current state-of-the-art commercial parts and technologies to improve fuel economy, noise reduction and exhaust emissions; reviewed failure data, performed modeling of potential technical approaches, developed 3D models of basic and redesigned engine configurations and designed and integrated engine changes for new parts.
- 3010 Congressional directed add for a Government/University effort to assess and develop promising alternative vehicle propulsion technologies such as natural gas, fuel cell power sources, electric drive systems and other propulsion technologies for military applications; began technical work to demonstrate critical diesel fuel reforming technology for use with fuel cell power systems on a Class 8 commercial truck chassis equipped with a hybrid electric drive system.
- 1365 - Completed preliminary demonstration of state-of-the-art high output military vehicle diesel engine technologies that will improve fuel efficiency and performance.
  - Demonstrated a portable blend/filtration system for waste engine oil reutilization for military ground vehicles.
- 1592 - Integrated and demonstrated flat panel display, navigation system, and interactive diagnostic computer into “smart truck” demonstrator.
  - Completed planning for the integration of key advanced commercial automotive technologies (engine, brakes, air conditioning, diagnostics, crash protection) into the light and heavy wheeled vehicle demonstrators.

Total 22702

FY 1999 Planned Program:

- 13788 - Under the Dual-Use Application Program (DUAP), develop and demonstrate series and parallel hybrid electric drive, engine injection system and supercharger design improvements, improved engine configurations, and advanced lightweight materials; new simulation tools in a distributed interactive environment for real world simulation of ground vehicle operation and analysis of man-machine interface.
- 4000 - Integrate key commercial automotive technologies (engine, brakes, air-conditioning, diagnostics, crash protection) into light and heavy wheeled demonstrators and engine, air-conditioning, diagnostics technologies into tracked vehicle demonstrator.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A Combat Vehicle and Automotive Technology
	PROJECT AH77

- Integrate commercial computer aided (CAD) components within the automotive based product development software framework (APDF).

FY 1999 Planned Program: (continued)

- Build, test and validate redesigned 6.2 L engine, implement changes based on testing results, build two engines, integrate redesigned engine into the HMMWV.
- Demonstrate critical diesel fuel reforming technology for use with fuel cell power systems on a Class 8 commercial truck. chassis equipped with a hybrid electric drive system.

•	420	- Participate in Simulation Based Acquisition demonstration for the Total Life Cycle (SIM-TLC).
•	445	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	18653	

FY 2000 Planned Program:

•	12646	- Develop and demonstrate, under DUAP, technologies to improve fuel efficiency through engine research, hybrid -electric FMTV, Class 8 parallel hybrid electric line haul truck, manufacturing innovation through man-in-the-loop simulation and collaborative design, development of the virtual distributed collaborative environment and creating a vehicle and heavy vehicle equipment virtual proving ground, and enhancing soldier safety through the development of the personal visualization environment. - Perform HMMWV vehicle endurance tests with reconfigured 6.2L engine, perform producibility study, conduct O&S cost assessment and analysis.
•	4000	- Integrate key commercial automotive technologies (engine, brakes, air conditioning, diagnostics, crash protection) into the light and heavy wheeled demonstrators and engine, air conditioning, diagnostics technologies into the tracked vehicle demonstrator.
Total	16646	

FY 2001 Planned Program:

•	12664	- Develop and demonstrate automotive technologies under the Dual-Use Application Program (DUAP) in the areas of fuel efficiency, vehicle modernization, manufacturing, automotive logistics and maintenance improvement.
•	4000	- Integrate key commercial automotive technologies (engine, brakes, air conditioning, diagnostics, crash protection) into the light and heavy wheeled demonstrators and engine, air conditioning, diagnostics technologies into the tracked vehicle demonstrator.
Total	16664	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

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

PROJECT: AH82

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH82 Non-Ozone Depleting Substance Technology	2273	1342	0	0	0	0	0	0	0	3627

Mission Description and Justification: This project demonstrates environmentally and toxicologically acceptable replacements for Halon 1301 in fire suppression systems in crew occupied compartments of ground combat vehicles. Due to the ozone depleting potential of Halon 1301, the Clean Air Act of 1990 and DoD Directive 6050.9 require that alternate extinguishing agents be identified to maintain current crew and vehicle survivability and supportability. Testing will be performed to meet Tier 1-3 Army Surgeon General and Environmental Protection Agency requirements. Object of this project is to identify and evaluate non-ozone depleting fire suppression substances for application to military vehicles. Investments to date have been successful in identifying two agents suitable for ground vehicle engine compartments. This project complements the DoD Next Generation Fire Suppression Technology Program to identify materials more suitable than currently available alternatives for vehicle crew compartments. System development contractors include Santa Barbara Dual Spectrum, Goleta, CA; Primex Aerospace, Redmond, WA; Pacific Scientific, Duarte, CA; and Walter Kidde Aerospace, Wilson, NC. Alternative agents are purchased from DuPont Inc., Deepwater, NJ and Great Lakes Chemical, Lafayette, IN.

FY 1998 Accomplishments:

- 852 - Continued performance testing of alternative agents.
- 861 - Conducted research in fire suppression principles, modeling, and instrumentation under DoD Next Generation Fire Suppression Technology Program.
- 560 - Continued tier 3 (long term; up to three years, multiple exposure) chronic toxicology studies for 8 alternative agents.
  - Developed system design guidelines for alternative agents.
  - Conducted toxicology studies of break-down products determined in the preliminary tier 2 studies for 8 alternative agents.

Total 2273

FY 1999 Planned Program:

- 977 - Continue performance testing of 6 selected alternative fire extinguishing systems.
  - Complete long-term toxicology studies initiated in previous year.
- 342 - Complete system design guidelines to integrate selected agent and delivery system into affected vehicles.
  - Complete breakdown product studies of 8 alternative agents.
- 23 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1342

FY 2000 Planned Program: Project not funded in FY00.

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology**

FY 2001 Planned Program: Project not funded in FY01.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology**
	PROJECT **AH91**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH91 Tank and Automotive Technology	12717	9122	14650	15935	17162	18457	21374	22392	Continuing	Continuing

Mission Description and Justification: This project provides innovative vehicle concepts and component technologies leading to product improvements to fielded equipment and to the development of advanced systems that will enable the Army to maintain superiority to fight and survive against diverse threats. Conceptual designs, virtual prototyping, and performance analyses and battlefield wargaming of ground vehicle systems identify promising emerging technologies in support of approved and emerging U.S. Army Training and Doctrine Command (TRADOC) requirements. They also quantify benefits, burdens and trade-offs related to ground vehicle applications. The project includes eight areas: (1) vehicle concepts; (2) mobility; (3) integrated survivability; (4) vehicle electronics (VETRONICS) and intra-vehicle digitization; (5) advanced vehicle structures; (6) simulation/analysis; (7) military fuels and lubricants; and (8) water purification technology. Technology initiatives are being pursued to address advanced mobility, survivability and lethality requirements of lighter, digitized, more deployable vehicles. Activities are closely coordinated through the Army Training and Doctrine Command's Mounted and Dismounted Battlespace Battle Labs; Program Executive Office for Ground Combat and Support Systems; and the Army Research Laboratory (ARL), and the Defense Advanced Projects Research Agency (DARPA). This coordination increases opportunities for transition of advanced technologies into ground vehicles. Tank and automotive virtual prototyping provides seamless sharing of databases/engineering models, allowing more rapid and efficient integration, assessment and transfer of DoD and commercial vehicle technologies. Vehicle electronics will be based on adapting commercial electronic standards and architectures for combat vehicle battlefield unique requirements. The survivability technologies, which include non-armor approaches such as signature reduction, countermeasures, active protection, and damage reduction, complement, but do not duplicate, work performed under the armor exploratory development project (DC05) in this PE. Other government agencies include: Defense Advanced Research Projects Agency, Arlington, VA; Oakridge National Laboratory, Oakridge, TN; Red River Army Depot, Texarkana, TX. Major contractors include: Cadillac Gage Textron, New Orleans LA; Soucy International, Drummondville, Quebec; Pentastar, Huntsville, AL; Michigan Technological University, Houghton, MI; United Defense Limited Partnership, San Jose, CA; University of Texas, Arlington, TX; Oakland University, Rochester Hills, MI; Gonzales Engineering, Troy, MI; Boeing Corporation, St. Louis, MO; University of Dayton Research Center, Dayton, OH; Monterey Technologies Inc., Monterey, CA; DCS Corp, Alexandria, VA.; Texas Instruments, Dallas, TX; Southwest Research Institute, San Antonio, TX; Separation Systems Inc., San Diego, CA, Scientific Systems, Boston, MA; University of California, Berkley, CA.

FY 1998 Accomplishments:

- 4725 - Developed multiple vehicle concepts and performed technology surveys and assessments in support of TRADOC Integrated Concept Teams (ICTs) and Army Integrated Idea Team (IIT); concepts were used to establish requirements, determine payoffs and set technology development goals.
  - Performed subsystem integration assessments for advanced technology for future combat vehicles and develop refined concepts based on emerging combat vehicle requirements.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602601A Combat Vehicle and Automotive Technology**
	PROJECT **AH91**

FY 1998 Accomplishments: (continued)

- Conducted an evaluation and refined the virtual prototyping architecture, verifying the ability to reduce development time, cost and testing requirements when used in place of traditional development methods; initiated immersive ergonomic interactive solid models with rapid feedback in multiple databases.

- 4692 - Integrated roll control to semi-active suspension for a scout class vehicle to increase vehicle speed, and platform stability; tested band track at increased roadwheel unit loading; developed band track components for vehicle applications in the 25 ton weight class and investigated mine resistant track technology.
  - Completed a contracted study to define technology for combat vehicle diesel engine and propulsion system and proposed methods for propulsion system volume reduction; completed single cylinder engine component redesign; completed high temperature synthetic lubricant test; fabricated single cylinder ceramic coated piston test (Army part of US-Japan cooperative research agreement).
  - Completed demonstration of an innovative water purification technology to improve flow rate, shelf life, increased temperature and pH range and chlorine tolerance.

- 2974 - Performed study of optimum survivability suites for a scout class vehicle that led to the initial design of an integrated signature-ballistic side armor system.
  - Demonstrated feasibility of a fiber bundle periscope, completed optical system design using holographic diffuser, and performed laboratory analysis of laser limiting materials provided by U.S. Army Natick Research, Development and Engineering Center.
  - Developed three-dimensional (3D) audio, voice recognition and headtracker concept alternatives for future integration into mobile reduced crew testbed.

- 326 - Completed the NAC managed Congressional add for Focus: HOPE for advanced material manufacturing process effort; demonstrated design and development of the machine cell required to support production of diesel engine components for Army ground vehicles.

Total 12717

FY 1999 Planned Program:

- 1078 - Perform concept analysis for combat and combat support vehicle systems, with emphasis on a medium weight strike force, in support of the development of emerging operational requirements.

- 4059 - Develop electric actuator for active suspension units; evaluate semi-active suspension potential via simulation for improved ride and platform stability with roll control in 25 ton combat vehicle class; support development of increased durability nitrile rubber track and determine optimal mine resistant track technology.
  - Identify and down select fuel energy enhancement material; screen and test fuel additives.
  - Conduct high temperature lubricant evaluations on a multi-cylinder engine; conduct high temperature, high nickel alloy head material and coated piston test on high temperature capable single cylinder engine; leveraging with international cooperative research and development funds, conduct high power density test on a technology screening engine (Army part of US-Japan cooperative research agreement).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A Combat Vehicle and Automotive Technology
	PROJECT AH91

- 3291 - Demonstrate retrofittable wide angle optical viewing system design which can incorporate laser limiting materials.

FY 1999 Planned Program: (continued)

- Develop family of new, hybrid structures concepts and candidate integrated signature-ballistic armor system for light and medium weight future vehicle systems with detectability and real density reductions; establish baseline vehicle concepts, defense zones, and zone specific design criteria.
- Determine constraints, performance requirements, and analyze unique active protection hemispherical and KE countermeasures for universal threat application.
- Evaluate concept alternatives for voice recognition, 3D audio, and indirect vision driving; select approach, and conduct detailed design for future integration into mobile reduced crew testbed.

- 694 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9122

FY 2000 Planned Program:

- 6242 – Perform concept studies of combat and combat support systems ranging from near term mods to existing systems to mid and far term advanced systems in support of the development of emerging operational requirements documents and tech development; perform technology assessments and subsystem integration studies for future combat vehicles in support of the U.S. Army Training and Doctrine command and Headquarters.
- Develop advanced alternative vehicle platform concepts and perform associated analysis for novel vehicle concepts that provide very high strategic and tactical mobility.

- 3486 - Design and fabricate wheeled vehicle semi-active suspension; conduct field testing of the Electromechanical Suspension System (EMS) installed in the HMMWV to evaluate active suspension under strenuous cross country conditions including steering and braking at high speeds; use the field test data to fully tune vehicle handling algorithm for safe cross country operations.
- Conduct multi-cylinder engine dynamometer endurance testing on candidate energy enhancement materials; conduct engine emissions testing on candidate energy enhancement materials; initiate engine-fuel-lubricant compatibility evaluations with candidate energy enhancement materials.
- Initiate Phase II evaluations of JP 8+100; conduct dynamometer test to assess impact of +100 fuel additive in ground engines, initiate investigation of JP 8+100 effect to particle size distribution.

- 2922 - Develop optical hardware for retrofittable wide angle optical viewing system which can incorporate laser limiting materials.
- Analyze/optimize concept alternatives for ballistic and structural loads and project weight savings for each and complete the demonstration and optimization of an integrated signature-ballistic side armor system and transition hardware designs into future vehicle programs; define alternative structural design concepts for each zone; conduct preliminary design analysis; define alternative armor attachments and integrate candidate zone design concepts into alternative “hybrid” vehicle designs.
- Conduct initial active protection countermeasure and sensor field evaluations based on FY99 analysis.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601A Combat Vehicle and Automotive Technology
	PROJECT AH91

- Evaluate concept alternatives for semi-autonomous driving using robotics technology, select approach, and define architecture for integration into mobile reduced crew testbed.

FY 2000 Planned Program: (continued)

•	2000	- Continue to develop, test and characterize advance materials including ceramics, high temperature combustion optimization, low heat rejection technology, and advanced friction and wear phenomena (cooperative project with Japan).
Total	14650	

FY 2001 Planned Program:

•	7130	- Perform concept studies, and associated analysis of combat and combat support systems ranging from near term modifications of existing systems to mid and far term advanced systems in support of the development of emerging operational requirements documents and tech development. - Develop Future Infantry Vehicle (FIV) virtual prototype and perform detailed assessments in mobility, survivability, lethality, deployability and cost to prepare for follow-on tech demo in FY02 (Program supports TRADOC approved Mission Needs Statement (MNS) and TRADOC Heavy Forces Modernization Plan.
•	3250	- Install and test wheeled vehicle semi-active suspension; complete electromechanical active suspension algorithm refinement for wheeled vehicles and investigate electromechanical active suspension application for hyper-mobility in combat vehicles. - Continue engine-fuel-lubricant compatibility evaluations with candidate energy enhancement materials, enhance lubricants products to operate successfully with energy enhancement material, initiate field testing of energy enhanced materials; expand dynamometer tests to address other engine types; investigate onboard vehicle coalescer/filter to work with +100 additive complete particle size investigation.
•	2403	- Demonstrate retrofittable wide angle optical viewing system incorporating laser limiting materials. - Conduct simulations to determine viable system concept designs and complete active protection component countermeasure and sensor field evaluations. - Evaluate/validate performance levels via component structural and ballistic tests; perform preliminary structural and weight analysis of candidate “hybrid” vehicle designs; develop preliminary structural and ballistic performance with small element tests.
•	1152	- Design and develop Commander's Graphical User Interface (GUI) for semi-autonomous driving for future integration into mobile reduced crew testbed. - Transfer water purification technology from DARPA to the Army; investigate and evaluate mesoscopic scale technologies for individual water purification.
•	2000	- Continue to develop, test and characterize advance materials including ceramics, high temperature combustion optimization, low heat rejection technology, and advanced friction and wear phenomena (Cooperative Program with Japan).
Total	15935	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

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

PROJECT: BH74

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH74 Simulation Laboratory	5621	0	0	0	0	0	0	0	0	5621

Mission Description and Justification: This Congressionally directed program funded the completion of a modernization program of the Physical Simulation Laboratory at the U.S. Army Tank-Automotive Research, Development and Engineering Center. This effort integrated the virtual proving ground into the laboratory environment for engineering development and Synthetic Theater of War (STOW) exercises. This capability enabled the motion bases to be networked to the simulation community, allowing high fidelity interactive experiments for the evaluation of engineering related issues and soldier/machine interfaces. Through this upgrade, program managers of ground combat and support, combat mobility, and tactical vehicles have a simulation facility to determine battlefield effectiveness using fewer prototypes. Other elements of the work effort resulted in (1) upgrading hydraulic power supply and its cooling loop (cooling tower) which are necessary to provide the required oil pressure and flow to the motion bases, (2) improvements to existing tactical vehicle durability simulators, and (3) a military vehicle mass and inertia measurement device. The effort improved hardware/soldier-in-the-loop simulation using motion bases, an upgraded and more reliable hydraulic power supply, and more accurate tactical vehicle dynamics models. This effort has been completed, therefore, the Army has not budgeted any out-year funding.

FY 1998 Accomplishments:

- 3050 - Completed installation and integration of real-time motion base simulation technology into existing motion based simulator to enhance realism .
  - Conducted demonstrations of weapon and soldier in the loop simulations for vehicle program managers.
- 1756 - Completed installation of hydraulics and cooling system for multiple simulators.
- 815 - Completed installation of tactical vehicle characterization fixture for better model fidelity.

Total 5621

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602618A Ballistics Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	36678	27229	36287	37687	38462	39218	34461	35865	Continuing	Continuing
AH37 Liquid Propellant Technology	3779	0	0	0	0	0	0	0	0	11026
AH75 Electric Gun Technology	9020	3972	5457	5468	5415	5720	3670	3931	Continuing	Continuing
AH80 Ballistics Technology	20350	21958	30830	32219	33047	33498	30791	31934	Continuing	Continuing
AH81 Armor/Anti-Armor Technology	3529	1299	0	0	0	0	0	0	0	4828

A. Mission Description and Budget Item Justification: This program element (PE) provides ballistic technologies required for armaments and armor to allow US dominance in future conflicts across a full spectrum of threats in a global context. Project AH37 completed the Army's work in liquid propellant technology. Project AH75 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 AH80 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. It also supports applied research for a new class of vehicle control that will enable an unmanned land combat vehicle to intelligently follow a manned combat vehicle. Project AH81 ends in FY 1999 because armor technology development has been consolidated in PE 0602601A, Project DC05. Work in this program element has been coordinated with the other military services through the Weapons Technology Area Plan to prevent duplication of effort and to maximize the return on investment. One result of this process is the Army's leveraging of Navy and Defense Special Weapons Agency investments for ETC technology demonstrations. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602618A Ballistics Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	40042	31115	34900	38352
Appropriated Value	41317	27475		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1275	-246		
b. SBIR / STTR	-486			
c. Omnibus or Other Above Threshold Reductions	-128			
d. Below Threshold Reprogramming	-2750			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1387	+665
Current Budget Submit (FY 2000 / 2001 PB)	36678	27229	36287	37687

Change Summary Explanation: Funding – FY 1999 program reduced by Congress (-3640).

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602618A Ballistics Technology

PROJECT: AH37

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH37 Liquid Propellant Technology	3779	0	0	0	0	0	0	0	0	11026

Mission Description and Justification: This is a Congressionally Funded program; not part of the Army's core mission funded program. This project focuses on maturation of liquid propellant (LP) technology with the intent to evaluate LP as a means of achieving increased lethality and/or survivability for future weapons systems applications. Technology challenges including pressure oscillations, material compatibility, and reliability/durability of the propellant in a battlefield environment will be addressed and advantages of an LP weapon will be explored. The LP technology program is managed by the Army Research Laboratory - Aberdeen Proving Ground, MD with contractual efforts at General Dynamics Defense Systems (GDDS) - Pittsfield, MA and Burlington, VT; Wright-Malta Corp. - Malta, NY; Princeton Combustion Research Laboratory - Monmouth Junction, NJ; Institute for Defense Analysis (IDA) - Alexandria, VA; and Penn State University - University Park, PA.

FY 1998 Accomplishments:

- 3779 - Completed Identification and testing of concept for reliable ignition in a high performance liquid propellant gun.
  - Completed materials compatibility testing for specific gun hardware.
  - Completed medium-caliber liquid propellant gun firings to establish design of a high performance, regenerative liquid propellant gun.
  - Completed evaluation of Army user needs, technology pay-off for liquid propellant guns, and identified windows of opportunity.

Total 3779

FY 1999 Planned Program: Project not funded in FY 1999

FY 2000 Planned Program: Project not funded in FY 2000

FY 2001 Planned Program: Project not funded in FY 2001

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602618A Ballistics Technology	PROJECT: AH75

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH75 Electric Gun Technology	9020	3972	5457	5468	5415	5720	3670	3931	Continuing	Continuing

Mission Description and Justification: This project provides oversight and accountability for the Army electric armaments technology program, which is managed by the Army Research Laboratory at Aberdeen Proving Ground, MD. Future armored combat vehicles will require more lethal, yet compact main armament systems capable of defeating protection levels greatly in excess of currently experienced values. Electric armaments offer the potential to field a leap-ahead capability by providing hypervelocity and/or hyperenergy launch greatly above the ability of the conventional cannon. Electric 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 challenges associated with developing electric armament, in particular with developing pulse power for electromagnetic (EM) launch and advanced propellant performance for electrothermal chemical (ETC) weapon systems. This project funds a contractual effort to develop an efficient pulsed power system for electromagnetic (EM) launch. The goal is to demonstrate pulse power technology (rotating machines) with energy density of three Joules per gram (J/g) and to identify a clear potential for growth to ten J/g. Efforts in EM pulsed power systems are conducted by SAIC - Minneapolis, MN; CEM - Austin, TX; CAES - Cumberland, MD; and R-Cubed - Salt Lake City, UT. In addition, this project supports the development of electrothermal chemical (ETC) technology which is a joint effort with the Defense Special Weapons Agency (DSWA) with contractual efforts by SAIC - San Diego, CA; UDLP - Minneapolis, MN; Thiokol - Northeast, MD; and Olin - St. Marks, FL. The goal of the ETC effort is to demonstrate 14MJ from the 120mm, M256 Cannon. Following this demonstration ETC will be applied to medium caliber cannon with a goal of increasing muzzle energy by 25%.

FY 1998 Accomplishments:

•	9020	- Demonstrated sub-scale compulsator at full design limits into an EM (electromagnetic) gun.
		- Demonstrated substantial muzzle energy growth from a 120-mm, M256 cannon.
		- Designed EM launcher for next generation compulsator.
		- Tested advanced switch prototypes on sub-scale machines.
Total	9020	

FY 1999 Planned Program:

•	3872	- Measure electromagnetic signature of subscale compulsator.
		- Test effects of electromagnetic shielding on subscale compulsator performance.
		- Demonstrate 14 MJ muzzle energy from a 120-mm, M256 ETC cannon.
•	100	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	3972	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602618A Ballistics Technology	PROJECT AH75

FY 2000 Planned Program:

•	5457	- Design and build switch array for multi-phase, multi-pole control of compulsator. - Test single switch array at required peak current. - Build EM railgun test fixture. - In close coordination with ARDEC, design ETC ignition and propelling charge for medium caliber cannon. - Demonstrate scalability, ballistic tailorability, and temperature compensation of ETC technology in medium caliber cannon. - Identify ETC tailored propellants with reduced vulnerability.
Total	5457	

FY 2001 Planned Program:

•	5468	- Test complete switch array to control compulsator discharge into EM railgun test fixture. - Demonstrate controlled step-up toward increased muzzle energy goal in medium caliber ETC cannon using tailored solid propellants. - Demonstrate ETC compatibility with medium caliber conventional and cased telescope cartridges.
Total	5468	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602618A Ballistics Technology

PROJECT: AH80

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH80 Ballistics Technology	20350	21958	30830	32219	33047	33498	30791	31934	Continuing	Continuing

Mission Description and Justification: This project produces key technologies required for armaments and armor to allow U.S. dominance in future conflicts across a full spectrum of threats. The program focuses on lethality technologies for more lethal and more deployable weapons and on survivability technologies to lighten and protect the force. These ballistic technologies will support advances in vehicle survivability, direct fire armament capabilities, indirect fire support and weapons effectiveness. This project continues to support extensive experimental programs to advance the state-of-the-art in ballistics technologies. This project also provides key technologies for a new class of vehicle control that will enable an unmanned land combat vehicle to intelligently follow a manned combat vehicle. This new capability will enable a manned crew in a lightly armored vehicle to simultaneously expand its survivability and area of influence, maneuvering and engaging enemy forces without disclosing its own location. 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, Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center, Warren, MI; and the Missile Research, Development and Engineering Center, Huntsville, AL.

FY 1998 Accomplishments:

- 14182 - Advanced technologies such as recoil mitigation and range correction for munitions that provide enhanced capabilities for light forces in operations across the threat spectrum.
  - Applied advanced guidance technology to artillery projectiles, missiles, and fire control concepts to provide improved weapon accuracy and associated relief from logistic burden.
  - Investigated advanced basal and applique armor technology to provide new approaches to armor lighter weight vehicles.
  - Demonstrated proof-of-principal of critical tracking and kill mechanism technologies for the Counter Kinetic Energy (KE) Active Protection (CKE AP) concept which extends the engagement envelope for the defeat of tank-fired KE rounds beyond the outer skin of the vehicle. This effort is fully integrated into the Tank-Automotive Research, Development, and Engineering Center (TARDEC) Full Spectrum Active Protection Program and is cooperatively managed.
  - Enhanced direct fire lethality by developing novel penetrator technologies, to include long standoff shaped charge jets, highly effective nose shapes for medium-caliber ammunition, and lethal mechanisms for hypervelocity missiles.
- 4141 - Implemented blast damage algorithm for component damage from small warheads to optimize lethality/survivability of smart indirect-fire munitions/ground systems.
- 2027 - Implemented physical models of vulnerability and weapons effects in real time for interactive simulations.

Total 20350

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602618A Ballistics Technology	PROJECT AH80

FY 1999 Planned Program:

•	15684	- Develop performance tailoring and screening tools to enable future solid propellants with maximum energy and minimum vulnerability at affordable cost while balancing human factors, life cycle costs, erosivity and propellant performance in gun systems. - Identify and characterize launch disturbances to optimize guidance and flight technologies to extend range and improve accuracy of indirect fire weaponry. - Develop enabling technologies that will provide new operational capabilities to soldiers in low intensity conflicts and operations across the threat spectrum. - Enhance armor technologies to address the lethality of advanced threats and increase crew protection in lightweight vehicles. - Characterize and demonstrate dynamic, real-time operation of Passive IR Tracker (PIRT) vs. KE projectiles; test full-scale electromagnetically (EM) launched kill mechanism; evaluate initial compact high explosive (HE) launched kill mechanism design; conduct tests with depleted uranium and tungsten heavy alloy penetrators vs. improved blast warheads and select residual armor technology based on penetrator performance against medium-caliber threats. - Evaluate advanced lethality concepts including novel penetrators for missile systems, sheathed penetrators, shaped charge warhead concepts, new tungsten composites for penetrators, and LIDAR packaged for KE penetrator applications to increase the lethality of Army direct fire systems.
•	6157	- Develop ammunition response algorithms for rocket motor ignition and explosion to more accurately predict the survivability and lethality of U.S. Army weapon systems such as Crusader, FSCS, FCS, MLRS, HIMARS, M74 & M85 bomblets, and BAT P3I. - Provide engineering-based predictions of the subsystem capabilities of air and ground combat platforms after multiple impact combinations of direct and/or indirect fire threats.
•	117	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	21958	

FY 2000 Planned Program:

•	16460	- Evaluate candidate propellants produced by ARDEC and industry partners; establish comprehensive database for use by ammunition designers to enhance gun lethality at reduced vulnerability. - Perform complex numerical simulations of launch disturbances and critical damping of initial free flight motions for future smart munitions to extend range and improve accuracy for both direct and indirect fire weaponry. - Evaluate, in conjunction with Army users, operational concepts employing technologies such as advanced lightweight artillery weapons and systems to enhance positional awareness; employ distributed interactive simulations incorporating these systems to improve training. - Investigate an advanced armor system capable of defeating future medium caliber KE and shaped charge threats that is compatible with the goals of AAN. - Evaluate performance of candidate sensor suite and kill mechanism technologies that will enable the development of CKE AP and begin the down-select to those with the best growth potential toward the Full Spectrum Active Protection (FSAP) STO goals. Begin integration of tracker, kill mechanism and residual armor components into a CKE brassboard demonstration.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602618A Ballistics Technology
PROJECT AH80	

FY 2000 Planned Program: (Continued)

- Exploit emerging technologies in the area of lethal mechanisms for direct fire applications, especially sheathed penetrators, amorphous metals, fragmenting warhead designs for medium caliber ammunition, and extending rods.

• 6970 - Verify and validate select component-level ballistic algorithms to support development and Live Fire Test & Evaluation of over ten U.S. Army weapon systems, including ground, munition, aviation, and lightly armored systems.
- Develop physically based models to predict the probability of ignition of sustained diesel and JP-8 fuel fires in U.S. group combat systems with and without fire suppression systems.

• 2000 - Identify, test and evaluate vehicle integratable sensor technologies and compact, command-fused Kinetic Energy penetrator counter-munition concepts

• 400 - Demonstrate the feasibility of future large caliber ETC guns. Evaluate and select ETC technologies, design and fabrication two ETC-gun modules, test, and evaluate modules for feasibility of an ETC-gun weapon system integration info FMVS. (NATO funds: Partner Germany)

• 5000 - Develop critical machine perception and intelligent control technologies for an unmanned ground vehicle/weapon carrier to autonomously follow a manned lead vehicle in cooperation with the Tank-Automotive Research, Development and Engineering Center.

Total 30830

FY 2001 Planned Program:

• 19577 - Implement selected gun propellant formulations (sample sizes) in scaled ballistic studies to demonstrate improved performance and propellant integrity with reduced vulnerability.
- Conduct experimental demonstrations of multi-disciplinary designs for guidance, navigation, and control technologies applied to smart munitions.
- Transition technologies which will provide new operational capabilities to light forces operating in low intensity conflicts and rapid deployment scenarios to Army Research, Development, Engineering Centers and the user community.
- Design and characterize innovative armors, structures, protection mechanisms, and survivability concepts for future lightweight combat vehicle protection.
- Down select CKE technology options, complete the integration to a brassboard CKE AP system and commence testing to optimize performance of the selected system.
- Develop novel lethal penetrator concepts to include explosively-assisted penetrators, hypervelocity penetrator concepts (e.g., segmented rods), and novel shaped charge liner configurations to defeat increasing levels of armor protection.

• 7232 - Implement advanced armor penetration algorithms in survivability/lethality analysis codes for sophisticated multi-layering schemes and functionally-graded material technologies under development for multi-hit protection of U.S. Army ground systems (such as C2V, FSCS, and FIV).
- Improve compartment and component-level analysis codes to predict the survivability, vulnerability, and lethality of next generation vehicle armament and propulsion systems.

• 2000 - Conduct experimental tests to demonstrate improved compactness and hardening of CKE technologies with specific focus on the sensor suite/counter-munition integration and optimization

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602618A Ballistics Technology
	PROJECT: AH80

FY 2001 Planned Program: (Continued)

- 410 - Demonstrate the feasibility of future large caliber ETC guns. Evaluate and select ETC technologies, design and fabrication two ETC-gun modules, test, and evaluate modules for feasibility of an ETC-gun weapon system integration info FMVS. (NATO funds: Partner Germany)
- 3000 - Initial demonstration/engineering evaluation of simple vehicle following "behaviors" for an integrated manned leader, intelligent unmanned follower tactical team

Total 32219

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602618A Ballistics Technology

PROJECT: AH81

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH81 Armor/Anti-Armor Technology	3529	1299	0	0	0	0	0	0	0	4828

Mission Description and Justification: The objective of this project has been to provide significantly increased levels of protection and survivability to existing and future combat systems, and to provide significantly increased lethality and effectiveness to existing and future anti-armor munitions by seeking novel and innovative solutions from industry. All of the funds in this project are used to fund contractual work to tap innovative ideas of industry. Anti-armor efforts develop technology to supports (1) a high priority Army program to enhance U.S. 120mm kinetic energy (KE) tank ammunition, especially against explosive reactive armor (ERA), which is available in the world arms market and is quite effective; (2) novel penetrators to improve munition effectiveness, and (3) an initiative to substantially extend the battlespace of the tank by developing technology needed for an extended range tank munition. Funding for these anti-armor efforts end in FY99. In FY 2000 and beyond, funds have been restructured to PE 0602601A, Project DC05, to consolidate armor technology development in a single project. Major contractors include: Dow Chemical Co., Midland, Miland Science Applications International Corp., Albuquerque, NM.

FY 1998 Accomplishments:

- 2479 - Completed KE precursor final design and transitioned to PE 0603004A, Proj D232, for cartridge integration.
  - Conducted exploration of novel penetrator designs to defeat advanced armor systems.
- 525 - Demonstrated top attack armor concepts employing electromagnetic defeat mechanisms and lightweight materials.
- 525 - Demonstrated light armor protection panels for scout-class vehicles.

Total 3529

FY 1999 Planned Program:

- 1274 - Demonstrate multi-liner explosively formed penetrator ability to form ultra-long penetrator and provide enhanced armor penetration from a smaller warhead configuration.
- 25 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1299

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602622A Chemical, Smoke and Equipment Defeating Technology**
	PROJECT **A552**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A552 Smoke/Novel Effects Munitions	3500	5078	3996	4042	4068	4110	4600	4845	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element provides applied research for technologies to increase survivability with enhanced smoke and obscurant capabilities, and solve critical light force needs to defeat enemy targets (i.e., non-lethal and flame/incendiary devices). Project A552 provides applied research of several capabilities to counter enemy weapon systems and to provide a capability to degrade enemy capability. Improved multispectral smokes/obscurants will be 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, all of which can operate anywhere from the visible through the microwave portion of the electromagnetic spectrum. These systems will be designed to be safe and environmentally acceptable. Flame and incendiary payloads will be developed to defeat a variety of targets ranging from personnel to bunkers and light armored vehicles. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. Efforts under this program element transition and provide risk reduction for demonstration and validation and engineering and manufacturing development programs.

FY 1998 Accomplishments:

- 3500 - Evaluated degradable and environmentally safe millimeter wave (MMW) screening obscurant candidates and conducted field trials; conducted packaging and dissemination studies; continued to investigate affordability issues.
  - Initiated investigation of propellant based obscurant dissemination for rapid obscuration concepts for combat vehicles.
  - Initiated millimeter wave module with the M56 smoke generator and its associated carrier; incorporated mission and operational cost reduction measures.

Total 3500

FY 1999 Planned Program:

- 2292 - Complete design and adaptation of the MMW module on the M56 and M58 smoke generators; implement cost and maintenance reduction measures.
  - Investigate vehicle smoke and obscurant acquisition and hit avoidance measures and concepts applicable to an integrated defense system for armored vehicles.
  - Investigate propellant dissemination obscurant technology for a smoke pot configuration.
- 2308 - Develop performance predictive capability for infrared (IR) materials.
  - Investigate improved dissemination and smoke generation techniques for IR materials.
  - Conduct smoke antimaterial feasibility assessment.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602622A Chemical, Smoke and Equipment Defeating Technology
	PROJECT A552

- 368 - Conduct investigations in flame, incendiary, anti-materiel, and riot control smoke technologies.

FY 1999 Planned Program: (Continued)

- Conclude thermite (aluminum and iron oxide pyrotectic reaction) scaling study.

110 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5078

FY 2000 Planned Program:

- 1626 - Conduct in depth field evaluations of the cloud produced by obscuration reinforcing system and propellant disseminated obscurant technologies.
- Apply propellant dissemination technologies for smoke pot configuration.
- Support transition of the MMW module to PM Smoke for Pre-Planned Product Improvement.
- 2370 - Investigate material expulsion methods and delivery mechanisms for multi-spectral smoke munition; complete IR theory.
- Assess distant smoke delivery methods.
- Investigate novel anti-materiel concepts, investigate novel marking/tagging concepts.

Total 3996

FY 2001 Planned Program:

- 1061 - Incorporate propellant dissemination technology in Vehicle Smoke Protection Model and Cloud Density Visualization Utility.
- Support smoke simulation in Combined Arms Tactical Trainer, High Level Architecture and Distributed Integration Simulation.
- Evaluate foreign emissive and pyrotechnic IR and multispectral concepts.
- Complete smoke pot investigation.
- 2981 - Formulate new multi-spectral smoke materials based on evaluation.
- Evaluate dissemination of new multi-spectral smoke materials.
- Down-select target defeat technology based on results of anti-materiel and marking concepts for prototyping/demonstration.

Total 4042

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

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

PROJECT: A552

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	3577	5116	4090	4132
Appropriated Value	3739	5116		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-162	-38		
b. SBIR / STTR	-58			
c. Omnibus or Other Above Threshold Reductions	-19			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-94	-90
Current Budget Submit (FY 2000 / 2001 PB)	3500	5078	3996	4042

THIS PAGE INTENTIONALLY LEFT BLANK

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602623A Joint Service Small Arms Program PROJECT AH21

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH21 Joint Service Small Arms Program	8714	5188	5187	5428	5611	5807	6079	6419	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objective of this Program Element (PE) is to develop key individual and crew served weapons technologies that will enhance the fighting capabilities and survivability of dismounted battlefield personnel of the Services. This PE funds efforts as follows: component technology for an Objective Crew-Served Weapon (OCSW) to replace selected M2 machine guns and MK19 grenade machine guns; bursting munitions technology to provide a 300% to 500% increase in hit probability, the ability to defeat defilade or non-visible targets, and means to extend the effective range of the Objective Individual Combat Weapon (OICW) to 1000 meters and the OCSW to 2000 meters; an objective sniper weapon technology to increase accuracy and effective range to 2000 meters for the next sniper weapon; technology advancement/enhancement efforts to 1) assure that the Objective Family of Small Arms, the next generation of weapons systems, continues to overmatch the evolving threat; and 2) address the follow-on needs of the Army After Next; other fighting technology alternatives promoting significant generic advances in function or form of small arms via a spectrum of applications from product improvements through all new weapon concepts (advanced materials and structures for gun systems, guided bullets, and explosively launched projectiles); and non-conventional target effects technologies for small arms-size directed energy systems (lasers/acoustics/microwaves), increased hit/incapacitation/suppression capabilities with controllable target effects (lethal to less-than-lethal). All Joint Service Small Arms Program (JSSAP) efforts are based upon the Joint Service Small Arms Master Plan (JSSAMP), and approved Joint Service Science and Technology Objectives (JSSTO), plus Mission Needs Statements and Operational Requirements Documents of the Services. The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology), PE 0603607A (Joint Service Small Arms Program), and will transition to JSSAP efforts conducted in PE 0604802A (Weapons and Munitions-Engineering Development) and PE 0604601A (Objective Crew Served Weapon-Engineering Development). Additional transition paths have been established in coordination with Product Manager (PM) Small Arms, USMC Program Manager (PM) Ground Weapons and US SOCOM.

FY 1998 Accomplishments:

•	5460	- Integrated OCSW weapon/mount components into prototype weapon system; conducted first firing demonstration. - Conducted design analysis for OCSW refinement phase including integration of single shot and burst fire fire control technology to meet OCSW 2000 meter requirement.
•	1600	- Updated simulator capability for OICW training during Advanced Technology Demonstration (ATD). - Conducted initial test range facility modernization for OICW safety/technical testing.
•	1654	- Conducted initial sniper baseline performance experiments. - Explored new concepts/technologies and role/requirements for “small arms” in Army After Next (AAN). - Completed fighting technology alternatives feasibility demonstration and non-conventional target effects technology assessment of directed energy.
Total	8714	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602623A Joint Service Small Arms Program — PROJECT: AH21

FY 1999 Planned Program:

•	2658	- Apply fire control technology to OCSW and plan full integration into prototype system design.
		- Conduct design refinements on OCSW weapon, ground mount, fuze and ammunition elements.
•	1076	- Following OICW safety certification, conduct technical and user testing.
•	1359	- Establish sniper baseline performance and explore new concepts/technologies to achieve future sniper requirements.
		- Evolve leading edge concepts/technologies that address AAN requirements.
•	95	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	5188	

FY 2000 Planned Program:

•	3506	- Complete integration of airburst, point-detonation and self-destruct functions into OCSW fuze.
		- Conduct firing demonstration tests of fully integrated OCSW fuze from 800 out to 2000 meters.
•	715	- Conduct simulation and analyses of Objective Sniper Weapon (OSW) concepts.
•	625	- Conduct analysis and planning for initial OICW block modification.
•	341	- Complete assessment of sensor technology for Light Fighter Lethality After Next.
Total	5187	

FY 2001 Planned Program:

•	3013	- Complete design and 1000-2000 meter firing tests of OCSW full solution fire control.
•	1275	- Evaluate key OSW components/pacing technologies; results fed back to virtual simulation.
		- Develop laser steering components for integration into OICW fire control.
•	1140	- Complete the concept of a seeker projectile for Light Fighter Lethality After Next.
Total	5428	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602623A Joint Service Small Arms Program

PROJECT: AH21

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	9000	5229	5239	5453
Appropriated Value	9286	5229		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-286	-41		
b. SBIR / STTR	-215			
c. Omnibus or Other Above Threshold Reduction	-71			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-52	-25
Current Budget Submit (FY 2000/2001 PB)	8714	5188	5187	5428

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	27962	28913	34687	37487	38180	39412	39968	41815	Continuing	Continuing
AH18 Artillery & Combat Support Technology	9857	11231	12645	14062	14326	14720	15279	15611	Continuing	Continuing
AH19 Close Combat Weaponry	6131	8613	11409	11714	11735	12136	11935	12697	Continuing	Continuing
AH28 Munitions Technology	7291	9069	10633	11711	12119	12556	12754	13507	Continuing	Continuing
J03 Plastic Cased Ammunition	4683	0	0	0	0	0	0	0	0	4683

A. Mission Description and Budget Item Justification: The objective of this Program Element (PE) is to perform applied research of advanced direct and indirect fire weapons (except small arms) and munitions. The PE funds several efforts, including advanced weapon concepts and analysis supporting the Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD) to increase anti-armor capabilities and increase survivability for Early Entry Forces and the Direct Fire Lethality Initiative which develops technologies to provide tank main armament upgrade opportunities for fielded and future ground combat systems. The PE funds efforts to develop precision and extended range munitions and alternative defeat mechanisms of advanced artillery, mortars, area denial and armor systems for Army XXI and technology supporting Army After Next (AAN) capabilities. The PE also funds 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); high energy explosive technologies that increase projectile and warhead lethality; advanced armament fire control, and decision aids and software architecture; advanced acoustic sensor technology to enhance performance of smart munitions, technology advances in acoustic sensors and anti-armor anti-personnel area denial systems, and smart materials to improve accuracy and reduce operational and support (O&S) costs. This PE also includes work on thermal management of high performance, high rate of fire, large caliber guns, and advanced air-to-air guns in enhanced rotary wing aircraft (e.g., Apache and Comanche) armaments, as well as ways to make artillery systems more flexible and deployable through range extension and weight reduction technologies. The work in this PE is consistent with Army Vision 2010, Army After Next, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0602618A (Ballistics Technology), PE 0602623A (Joint Service Small Arms Program), and transitions to work performed in PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603607A (Joint Service Small Arms Program) and PE 0603802A (Weapons and Munitions Advanced Development).

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	29905	29489	33112	34768
Appropriated Value	30876	28189		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-971	-276		
b. SBIR / STTR	-227			
c. Omnibus or Other Above Threshold Reductions	-75			
d. Below Threshold Reprogramming	-1641			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1575	+2719
Current Budget Submit (FY 2000 / 2001 PB)	27962	28913	34687	37487

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology

PROJECT: AH18

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH18 Artillery & Combat Support Technology	9857	11231	12645	14062	14326	14720	15279	15611	Continuing	Continuing

Mission Description and Justification: This project focuses on the exploratory development of technology for cannon artillery, mortar weapon, fire control and combat support systems in support of next generation, Army Vision 2010, and Army After Next (AAN) systems. Also being pursued is technology for improving combat vehicle lethality and fire control while reducing life cycle costs with innovative applications of smart materials, advanced actuators, gearless electric drives, advanced digital stabilization and microelectromechanical technology for imbedded fire control sensors. Decision aid software technology is being developed to increase battlefield survivability of self-propelled howitzers, along with technologies for improving the effectiveness and affordability of next generation smart munitions. Global Positioning System (GPS) technology is being integrated into fuzing for mortar and artillery projectiles. This will significantly increase a projectile's overall delivery accuracy and also be readily applicable to the existing ammunition stockpile. Meteorological extraction algorithms are also being developed to further improve artillery projectile tracking accuracy. Technology for artillery projectile rotating and obturating bands is being pursued to address an impending shortcoming when firing from high performance cannons. Recoil management and lightweight materials technologies are being developed to create a more lethal, yet lightweight Advanced Technology Lightweight Artillery System (ATLAS). Such technologies will support mobility and deployability strategies envisioned for the AAN. The application of light-weight, high-strength composites to mortar projectiles is being pursued to significantly extend range while providing increased lethal effectiveness, such as the Extended Range Mortar Cartridge (ERMC) program. This project also supports a pulsed-power technology assessment of electric gun applications to support more energetic, lethal and longer range projectiles, and the development and evaluation of advanced area denial concepts as an alternative to current anti-vehicle/anti-personnel mining techniques. This project also funds technology to develop advanced acoustic sensors which will provide non-line of sight target queuing for a variety of weapons platforms. Technologies for reducing artillery target location error and providing real time targeting and battle damage assessment data to fire directions centers are also being developed to support information dominance strategies for both Army Vision 2010 and AAN. Development of the Distributed Interactive Fire Mission (DIFM) software supports Army XXI and AAN fire control systems. This software will enable groups of tanks, fighting vehicles, attack helicopters, etc. to fight in unison by coordinating their fires against targets; substantially improving battlefield survivability and operations tempo. Targets will be automatically assigned to individual shooters based on the most effective pattern to ensure rapid first-shot execution and progression to the next target assignment. Quicklook provides the brigade commander with real time target imagery, coordinates, and battle damage assessment (BDA). This system will utilize an artillery launched unmanned aerial vehicle that flies out to a maximum range of 50 km. and acquires and transmits targeting information (i.e., video, GPS) back to the tactical operations center (TOC) via a wireless link.

FY 1998 Accomplishments:

- 4398 - Integrated hardware onto Paladin howitzer as part of an auto-registration accuracy improvement program; investigated GPS fuze integration and anti-jam technologies with the Army Research Labs.
  - Analyzed SADARM Block II requirements for the next generation of smart artillery munitions; finalized sensor concepts and fabricate prototype hardware for sensor concept evaluation.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602624A Weapons and Munitions Technology
	PROJECT AH18

FY 1998 Accomplishments: (continued)

- Demonstrated Meteorological (MET) extraction techniques for Crusader artillery system; defined baseline fire support targeting sensor system requirements and completed critical subsystem designs (sensor, GPS receiver/ guidance, airframe/control and data link/ground station) to achieve real time targeting and battle damage assessment for artillery in support of AAN strategies.
- Evaluated a deployment version of the area denial concept as an alternative to conventional mining techniques; tested alternate sensor technologies for personnel detection in realistic environments and lethal and non-lethal defeat mechanisms.

• 3069
- Fabricated gearless azimuth drive and smart barrel actuators for improved accuracy combat vehicle gun systems; designed low cost, more accurate optical fiber based muzzle reference system; mounted optical fiber on 120mm gun.
- Developed baseline executable reference architecture software specification/ model for weapon systems; demonstrated application of a formal Reference Architecture specification for rapid component generation, integration and reuse; generation of this capability will provide long term benefits in support of AAN information dominance strategies.
- Conducted final gun testing of high performance rotating band and obturator designs under worse case conditions (worn-tubes, maximum muzzle velocity); evaluated design performance.
- Continued support of RFPI ACTD acoustic sensor effort; verify accuracy of acoustic sensor performance and propagation models; demonstrated 1) a preliminary tactical decision aid tool, 2) target acquisition and tracking capabilities of the Integrated Acoustic Sensor for RFPI and 3) acoustic propagation prediction capability using Defense Advanced Research Projects Agency (DARPA) internetted unattended ground (IUG) sensors.

• 2390
- Integrated knowledge base and rule development of decision aids utilizing digitized battlefield plans and procedures; integrated route planning and site selection decision aid modules into the distributed interactive simulation (DIS) environment for the Division Task Force XXI Advanced Warfighting Experiment (AWE).
- Performed interior ballistics modeling for ultra-lightweight direct support artillery weapon; created virtual prototype and model of 6750 lb. soft recoil test bed; developed an Army data base of electro-rheological fluids; development will support AAN mobility and deployability strategies.
- Completed ERMC rocket motor, fuzing and payload deployment designs; completed interior and exterior ballistic analyses.
- Conducted simulations in support of Battle Lab AWEs and Armament Research, Development and Engineering Center (ARDEC) RFPI programs; reviewed/updated Future Combat System (FCS) main armament system pulsed power technology alternatives.

Total 9857

FY 1999 Planned Program:

• 3387
- Fabricate a cannon for ultra lightweight 155mm ATLAS and modify soft recoil test bed; develop concepts for 5700 lb. electro-rheological fluid-controlled soft recoil weapon in support of AAN mobility strategies; design upper carriage and tipping parts for testbed.
- Gather area denial intrusion sensor data in various terrain and weather conditions; develop computer algorithms; conduct simulation to evaluate operational effectiveness.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602624A Weapons and Munitions Technology
	PROJECT AH18

- 3238 - Develop and demonstrate a network accessible reference architecture data repository of reusable fire mission components; develop and demonstrate a baseline reusable voice natural language interface component for fire missions; develop process tools to support a "software component factory" approach to affordable embedded software development; this effort supports Army XXI and AAN information dominance strategies.

FY 1999 Planned Program: (continued)

- Complete implementation and battle lab evaluation of Technical Architecture-compliant fire mission and movement planning decision aid for an artillery chief-of-section.
- Complete capture of armament decision aid knowledge base; complete hardware, software and DIS integration efforts; test and verify operation of new decision aid components; conduct man-in-the-loop testing.
- Analyze and apply results of the Distributed Interactive Fire Mission (DIFM) Concept Experimentation Program conducted by the Mounted Maneuver Battle Space Battle Lab which will develop multi-shooter long range armored fighting vehicle battle scenarios for DIFM simulations.

- 2840 - Fabricate prototype components of weapons systems using smart materials and structures technology to significantly improve functionality, reduce size, costs, weight, improve or maintain existing lethality, jumpstart the development of AAN systems and DARPA investments.
- Establish preliminary concepts and conduct trade-off analyses of novel AAN era indirect fire systems.
- Refine acoustics tactical decision aid components for environmental characterization, propagation prediction and artificial intelligence rule-based acoustic sensor deployment planner. Develop algorithms and components for acoustic sensors to 1) detect, locate and cue fire finder radars to counter cannon artillery and artillery rocket fires and 2) locate snipers.
- Fabricate test hardware and lightweight rocket motor for ERMC; conduct interior ballistics tests; perform combat utility simulations.

- 1519 - Develop tactical targeting and battle damage assessment munition (i.e. Quicklook) operational architecture and procedures; perform studies on battlefield payoffs, target location, logistics, communication architecture and system design concept; develop system design.
- Develop retrofit obturator to improve projectile accuracy and minimize cannon wear for extended range weapon systems; conduct subscale testing of advanced polymer materials for obturator application.

- 247 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 11231

FY 2000 Planned Program:

- 4834 - Fabricate hardware and conduct preliminary tower/Captive Flight Tests (CFT) to validate common aperture laser radar infrared (LADAR/IR) sensor performance against low observable targets; fabricate prototype sensor hardware for gun-hardening experiments. These sensors are applicable to munitions such as the Tank Extended Range Munition (TERM) and the XM982 Extended Range Guided Munition (ERGM), and information reconnaissance hardware such as tactical unmanned aerial vehicle (UAV).
- Conduct field test of prototype area denial hardware; evaluate weapons system and sensor performance; evaluate system effectiveness.
- Execute firing test of electro-rheological fluid control recoil system for ATLAS; complete design of 5700 lb. direct support firing platform.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602624A Weapons and Munitions Technology
	PROJECT AH18

- 4200 - Extend the fire mission and movement planning decision aid to a fully Technical Architecture compliant suite of decision aid components to support sustainment, situational awareness and mission rehearsal for an artillery chief-of-section; establish a baseline decision aids application software component reuse library and link with specification data library to support follow-on software component factory technology.
  - Develop DIFM multi-shooter vs. multi-target algorithms.

FY 2000 Planned Program: (continued)

- Develop concepts and technologies for remotely deployed acoustic sensor to better detect, locate and classify airborne-ground targets and cannon and rocket artillery; demonstrate capability of environmental sensors such as wind speed and direction integrated with acoustic sensors as a decision aid tool to assist battlefield commanders in sensor deployment and estimation of sensor effectiveness in various weather conditions.

- 3611 - Fabricate Quicklook artillery fired unmanned aerial vehicle reconnaissance system hardware components and perform sub-system testing.
  - Complete ERMC rocket motor static testing; update interior and exterior ballistic models.
  - Demonstrate obturation effectiveness and improve system accuracy; investigate supplemental torque driving capability of design for higher muzzle energy launch.
  - Develop virtual/computer design of novel AAN era indirect fire system for Training and Doctrine Command (TRADOC) wargames; define preliminary architecture for distributed fire engagement.

Total 12645

FY 2001 Planned Program:

- 4500 - Conduct system trade-off studies, procure sensor hardware and perform captive flight tests on alternate sensor designs with a common aperture laser radar infrared (LADAR/IR) transducer for detection of Low Observables (LO).
  - Fabricate 5700 lb. ATLAS; perform limited firing tests to assess stability, precision and accuracy.
  - Conduct Area Denial System demonstration.
- 3299 - Complete implementation and feasibility demonstration of an architecture-based software component factory process for rapid generation of embedded fire mission application software.
  - Complete DIFM multi-shooter algorithms development; analyze and optimize DIFM using Distributed Interactive Simulation; quantify DIFM multi-agent performance.
  - Fabricate and demonstrate prototype hardware via flight test as the ERMC.
- 6263 - Integrate Quicklook system components and perform integrated CFT.
  - Complete technical assessment and operational requirements of novel AAN era concepts for indirect fires, develop architecture and technical feasibility for a massed, precision fire attack.
  - Demonstrate improved cannon wear life (Crusader) in wear testing; verify design improvements for stockpiled ammunition.
  - Fabricate and field test acoustic sensor system concepts to demonstrate detection, location, and classification of airborne/ground targets and cannon and rocket artillery; conduct modeling and simulation in support of Army Vision 2010 and AAN fire control, weapons and area denial systems.

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602624A Weapons and Munitions Technology**

Total 14062

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology

PROJECT: AH19

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH19 Close Combat Weaponry	6131	8613	11409	11714	11735	12136	11935	12697	Continuing	Continuing

Mission Description and Justification: The objective of this project is to exploit and advance new technologies which will demonstrate significant improvements in direct fire weapon performance for ground and air combat vehicles. Principal efforts support the Direct Fire Lethality program. Included are technologies for the tank projectile precursor defeat of explosive reactive armor (ERA), composites for sabots and gun structures, and trajectory correction mechanisms. In addition, this project develops technologies in the areas of weapon stabilization, projectile design and fabrication, means to increase gun life by reducing barrel wear, thermal management of high rate launch mechanisms and munition auto-loaders, feeders and storage mechanisms. The project also develops extended range munitions and alternative defeat mechanisms of advanced armor systems for Army After Next. This project provides opportunities for longer range, more accurate and more lethal cannon systems for armored vehicle upgrades (e.g., Abrams, Bradley Fighting Vehicle System (BFVS), Future Combat System, Future Scout and Cavalry system) and for future systems. The approach will be to develop both the hardware and analytical tools necessary to assess system performance, identify problem areas and to develop solutions

FY 1998 Accomplishments:

- 3031 - Conducted performance simulations of novel penetrator capabilities against advanced armors for development of advanced armor defeat mechanisms applicable for both near term and Army After Next (AAN).
  - Performed 120mm kinetic energy (KE) projectile dispersion test for enhanced accuracy.
- 800 - Evaluated and downselected extended range munitions designs.
- 1300 - Completed assessment of bursting munitions and KE penetrator technologies for enhanced lethality for future scout and aviation platform applications.
- 1000 - Evaluated results of coating adhesion, morphology and thickness distribution of 25mm gun tubes for increased wear life.

Total 6131

FY 1999 Planned Program:

- 5791 - Demonstrate KE radial thruster technology capability to measure and counter flight disturbances to enhance accuracy up to 70%.
  - Conduct analytical evaluation of extended range munition capabilities.
  - Demonstrate novel penetration defeat of future threat complex armors.
- 1738 - Develop lightweight, high performance armament systems technology for Army After Next applications (e.g., Multi-Role Aviation Weapon System).
- 979 - Complete adhesive test of sputter coated 25mm gun barrels.
- 105 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 8613

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology
PROJECT: AH19	

FY 2000 Planned Program:

•	1500	- Deposit tantalum coating by cylindrical magnetron sputtering process on test coupons, cylindrical sections and a full length 25mm gun barrel.
•	2297	- Conduct simulation of existing and conceptual target defeat techniques (i.e., Institute of Advanced Technology (University of Texas), Armament Research, Development and Engineering Center (ARDEC), and Army Research Laboratory).
•	2849	- Analyze, simulate and select lethality package for electro-thermal-chemical and other conventional propulsion systems for future combat system.
	2203	- Complete design of precision electric turret drive system as part of the Multi-Role Aviation Weapon System.
•	460	- Complete preliminary concept design(s) for variable lethality munitions.
•	2100	- Issue broad area announcement to develop medium caliber munition concepts that will provide future combat vehicles with close-in self-defense capability by deterring threat sensors.
Total	11409	

FY 2001 Planned Program:

•	1500	- Test fire a full length 25mm gun barrel with tantalum coating to validate wear performance.
•	1890	- Demonstrate control capabilities of a precision electric turret drive system.
•	6039	- Complete fabrication of lightweight/low impulse hybrid electrothermal-chemical launcher.
		- Demonstrate ammunition and defeat of future combat system target arrays representing the threat (100% increase over M829A2).
•	1100	- Fabricate and test sub-systems for variable lethality munitions.
•	1185	- Design competing threat sensor deterring munitions for technology demonstration.
Total	11714	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology

PROJECT: AH28

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH28 Munitions Technology	7291	9069	10633	11711	12119	12556	12754	13507	Continuing	Continuing

Mission Description and Justification: This project supports advanced technologies in gun propellants with wear reducing additives, explosives, warheads, insensitive munitions (IM) and advanced materials for anti-armor warheads in support of next generation and Army After Next systems. Advances in warhead technology will provide improved explosively formed penetrators (EFP), shaped charges (SC) and advanced warhead liners to defeat as well as protect current and future systems. High energy/density explosives are needed to increase lethality. New, improved energetic materials have numerous transition opportunities for weapons system upgrades. The IM efforts conducted in this project will increase the survivability of tanks, artillery, helicopters and infantry fighting vehicles, as well as safety in manufacturing plants, storage depots, and air and sea transport.

FY 1998 Accomplishments:

- 2780 - Scaled up more powerful explosives and planned study for anti-armor warhead loading; new CL-20 formulations showed promise for performance and sensitivity.
- 3207 - Demonstrated selective warhead design to defeat heavy armored targets (15-20% increase in performance over state-of-the-art warheads) or lightly armored targets (four fold increase in lethal area over current shaped charges).
- 1304 - Demonstrated high energy high performance gun propellant in live firings (impetus values 10-20% over JA2).

Total 7291

FY 1999 Planned Program:

- 3030 - Conduct static warhead tests using high power explosives to show an increase in energy performance for next generation and Army After Next systems of up to 25%.
- 3027 - Build on warhead designs demonstrated in FY 1998 to develop advanced lightweight/compact warhead concepts to defeat current and future advanced armor.
- 1818 - Conduct studies on the processibility of thermoplastic elastomers and the effect of binder/plasticizer type and ratio on energetic materials to provide higher energy, safer gun propellant; investigate additives to reduce gun tube wear.
- 1065 - Design multiple explosively formed penetrator warhead for active protection against chemical energy and kinetic energy threats.
- 129 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9069

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology
	PROJECT: AH28

FY 2000 Planned Program:

- 3080 - Synthesize more powerful explosives, including tetrazatetranitrocubane (TATNC), and scale-up other viable formulations.
- 3823 - Conduct testing of combined ant-armor/anti-bunker warheads.
- 1930 - Formulate and test CL-20 based advanced propellants.
- 1800 - Design/fabricate/test an EFP warhead for active protection system.

Total 10633

FY 2001 Planned Program:

- 3471 - Characterize TATNC and develop formulations.
- 4520 - Demonstrate compact/multiple effects warhead and design/optimize the co-linear explosively formed penetrator warhead.
- 1920 - Demonstrate significant propulsion performance increase in scaled and large caliber guns.
- 1800 - Conduct dynamic tests of EFP warhead for active protection system against chemical and kinetic energy threats.

Total 11711

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602624A Weapons and Munitions Technology

PROJECT: J03

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
J03 Plastic Cased Ammunition	4683	0	0	0	0	0	0	0	0	4683

Mission Description and Justification: This project is a Congressional plus-up for the development and certification of small caliber plastic cased ammunition. In accordance with guidance from Congress, funds were transferred to the U.S. Navy for execution of program.

FY 1998 Accomplishments:

- 4683 Program execution by U.S. Navy in accordance with guidance from Congress.

Total 4683

FY 1999 Planned Program: This project is not funded in FY 1999**.**

FY 2000 Planned Program: This project is not funded in FY 2000.

FY 2001 Planned Program: This project is not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602705A Electronics and Electronic Devices

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	23974	25238	25796	27719	29554	31543	30070	31840	Continuing	Continuing
AH11 Battery/Individual Power Technologies	5439	6515	4338	4042	4501	4569	2682	2810	Continuing	Continuing
AH94 Electronics and Electronic Devices	17130	18723	21458	23677	25053	26974	27388	29030	Continuing	Continuing
AJ04 Thermophotovoltaic Generator	1405	0	0	0	0	0	0	0	0	1405

A. Mission Description and Budget Item Justification: This program consists of research in the physical sciences essential to all land combat systems that contain electronics, chemical/biological sensors, photonics, magnetic materials, ferroelectrics, microwave and millimeter-wave components, batteries, electromechanical systems (engine generator sets) and fuel cells. Supported systems include the Future Soldier System (FSS), autonomous missile systems, advanced land combat vehicles, smart anti-tank munitions, electric weapons, secure jam-resistant communication, automatic target recognition (ATR), foliage-penetrating radar, combat identification, and digitizing of the battlefield. The work under this program element provides enabling capability 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 develop low-cost, lightweight, high-energy density power sources of power for communications, target acquisition, miniaturized displays, combat service support applications and microclimate cooling for Future Soldier System. Under Defense Reliance agreements, this program supports the in-house exploratory development effort at a single Army site which serves as both the center for display technology development and the center for frequency control and timing for the Army, Navy, Air Force, Ballistic Missile Defense Organization, and Defense Nuclear Agency. It supports all of the science and technology thrust areas that employ electronic and portable power-source technology. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602705A Electronics and Electronic Devices

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	24464	22329	23680	26506
Appropriated Value	26792	25479		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-828	-241		
b. SBIR / STTR	-359			
c. Omnibus or Other Above Threshold Adjustments	-1619			
d. Below Threshold Reprogramming	-12			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+2116	+1213
Current Budget Submit (FY 2000 / 2001 PB)	23974	25238	25796	27719

Change Summary Explanation: Funding: FY 1998 – DoD Internal Reprogramming realigned funds provided by Congress for enzyme-based chemical and biological detection technology from this PE (-1500) to the RDT&E Defense-Wide Appropriation for proper program execution.
FY 1999 – Congressional increase (+3150).

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602705A Electronics and Electronic Devices

PROJECT: AH11

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH11 Battery/Individual Power Technologies	5439	6515	4338	4042	4501	4569	2682	2810	Continuing	Continuing

Mission Description and Justification: This project provides applied research in the application of the physical sciences of energy conversion, electrochemistry, electronics, signature suppression, etc. as they apply to improving existing systems and enabling newer, more advanced battery, fuel cell, thermoelectric, hybrid, and electromechanical (including engines and permanent magnet alternators) technologies. The goal is to develop small, low-cost, environmentally compatible, light weight, high energy density sources of power for communications, target acquisition, miniaturized displays, combat service support applications, and future soldier systems. Technology developments support thrusts aimed at reduced acquisition costs, reduced operation and support costs, and Army modernization.

FY 1998 Accomplishments:

- 910 - Completed development of lithium manganese dioxide batteries for thermal weapon sight (TWS) and Land Warrior. These batteries are more cost effective than the present non-rechargeable lithium sulfur dioxide system for combat missions.
  - Completed specification development for safe, performance-optimized standard family of rechargeable lithium-ion batteries. These batteries provide lighter weight, lower operations and support cost to the present nickel cadmium and nickel metal hydride batteries.
- 332 - Completed the fabrication/test of a lightweight, manportable, electronically controlled, signature suppressed 3 kW generator set capable of starting and operating on multiple fuels. This 3 kW system was demonstrated to the User community during the rapid force projection initiative review at Ft. Benning.
  - Awarded contracts for the design and development of state of the art, efficient, lightweight 5 kW alternator/power electronic subsystems. Effort will lead to the modernization and upgrade of existing power systems.
- 917 - Designed, constructed and tested improved lightweight 50 and 150 watt fuel cell with 600 watt-hour capacity.
- 460 - Performed design analysis and engineering of lithium-ion coin cell batteries to replace obsolete mercury batteries for low power and memory hold applications.
- 930 - Demonstrated low cost reusable alkaline manganese battery for low power training applications.
  - Implemented new AA and C cell designs for high current discharge batteries used for military training. Fabricated prototype batteries and battery chargers for test and demonstration. Test resulted in AA cell design providing superior performance.
- 500 - Investigated components to develop high rate, large (fat D cell size), non-metallic rechargeable lithium-ion cells optimized for safety and performance for use in BB-X590/U military batteries.
- 1390 - Demonstrated feasibility of a high energy zinc-air system suitable for field recharging batteries.

Total 5439

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999	
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602705A Electronics and Electronic Devices	PROJECT AH11

FY 1999 Planned Program:

•	942	- Develop a rechargeable lithium-ion liquid electrolyte (wet cell) battery and non-rechargeable metal-air battery, both with ultra high energy density and low operations and support costs. - Develop and demonstrate prototype smart charging cables for forward field charging of rechargeable batteries for light infantry forces Command, Control, Communications, Computers, Intelligence and Information Warfare (C4I2W) equipment. - Develop and demonstrate vehicle-mounted chargers that utilizes vehicle power to recharge family of C4I2W batteries.
•	1224	- Perform design analysis and demonstrate proton exchange membrane (PEM) fuel cell/lithium-ion rechargeable battery hybrid power source components to provide smaller, lighter and more cost effective man-portable power systems for C4I2W equipment. - Investigate low power and power management technologies for applicability to Army C4I2W equipment.
•	528	- Design and develop a 350 pound portable, electronically controlled 5000 Watt engine driven generator set capable of operating on multiple fuels for tactically mobile use. The design shall integrate state-of-the-art commercially available engines with R&D alternator and power electronics technologies.
•	643	- Design liquid fueled 50 to 150 watt fuel cell with 2000 watt-hour per kilogram of fuel.
•	850	- Develop very high energy density, compact zinc-air coin cells for special mission requirements.
•	850	- Develop low cost, high rate rechargeable alkaline manganese batteries for training and garrison environments.
•	700	- Develop low cost, high rate non-rechargeable alkaline batteries for portable military communications applications.
•	650	- Develop low cost, rechargeable lithium-ion coin cells for low rate and memory hold applications for communications and COMSEC devices.
•	128	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	6515	

FY 2000 Planned Program:

•	976	- Develop lithium-ion polymer electrolyte (dry cell) rechargeable battery that provides higher safety and higher capacity than wet cell batteries for C4I2W training applications. - Develop and demonstrate prototype universal smart charging cables for charging complete family of military rechargeable batteries used for C4I2W applications. - Demonstrate proof-of-concept rechargeable vest battery for the multiple integrated laser engagement simulation (MILES) 2000.
•	2488	- Develop, fabricate and demonstrate components for cost-effective 5-150 Watt man-portable hybrid power sources for land warrior and forward field charging applications. - Develop and evaluate fueled energy sources (direct methanol/logistic fueled fuel cells, generators, thermophotovoltaics (TPV)) and mechanical energy converters (flywheels, coiled springs, etc.) for applicability in 300-500 watt and 5-10 kilowatt hybrid power sources for lightweight Tactical Operations Centers (TOCs) and future command posts. - Leverage appropriate DARPA low power electronics programs; develop and demonstrate a 1 volt dc-dc converter for future Army radio upgrade.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602705A Electronics and Electronic Devices — PROJECT: AH11

FY 2000 Planned Program: (Continued)

•	454	- Fabricate the 350 pound portable, electronically controlled 5000 Watt engine driven generator set capable of operating on multiple fuels for tactically mobile use. Investigate and use latest advances in composite materials and signature suppression techniques.
•	420	- Fabricate and test liquid fueled 50 to 150 watt fuel cell with 2000 watt-hour per kilogram of fuel.
Total	4338	

FY 2001 Planned Program:

•	910	- Develop, fabricate and demonstrate high energy rechargeable lithium-ion polymer electrolyte battery for the mini eyesafe laser infrared observation set (MELIOS). - Complete development and field test of manpack metal-air/universal smart charging cable recharging system for light infantry C4I2W equipment.
•	2318	- Complete evaluation of batteries, capacitors, fueled energy sources, and mechanical energy converters in the 5-150 W range for land warrior application and identify most promising, highest payback candidates for final development and field testing. - Complete evaluations of batteries, capacitors, fueled energy sources, and mechanical energy converters in the 300 W-10kW range for TOCs and identify most promising, highest payback candidates for final development and field testing. - Develop and integrate a low power efficient subsystem for Force XXI land warrior.
•	400	- Test and evaluate the 350 pound, 5000 Watt generator set prototype. Leverage design and test results and use them to establish operational and performance criteria for general power system designs for the 21st Century Family of generator sets (10 – 60 kW).
•	414	- Optimize the design of the liquid fueled 50 to 150 watt fuel cell with 2000 watt-hour per kilogram of fuel for field use.
Total	4042	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602705A Electronics and Electronic Devices	PROJECT AH94

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH94 Electronics and Electronic Devices	17130	18723	21458	23677	25053	26974	27388	29030	Continuing	Continuing

Mission Description and Justification: This project supports applied research in the application of the physical sciences of physics, electrochemistry, biotechnology, electronics, and process science, as they apply to improving existing systems and enabling newer, more advanced systems. Technology developments support thrusts aimed at reduced acquisition cost, reduced operations and support costs, Army modernization, Advanced Technology Demonstrations (ATDs) and Advanced Technology Transition Demonstrations, as described in the Army Science and Technology Master Plan.

FY 1998 Accomplishments:

- 6517 - Evaluated ferroelectric thin-film millimeter wave scanning antenna to demonstrate electronic scanning.
  - Demonstrated MW/MMW/terahertz devices for communications/navigation/surveillance systems.
  - Developed predictive physics-based and circuit-based modeling and simulation tools for circuits, leveraging high performance computing assets.
  - Assessed application of digital receiver technology and Microelectromechanical Systems (MEMS) for application to low cost MMW radar.
  - Demonstrated performance Ku band rotman escan antenna with an octave of bandwidth.
  - Developed 5W 35 GHz power amplifier module design concept.
  - Established SiC thyrister process to support high power switching requirements of all electric vehicle program.
- 1800 - Executed DoD-mandated program to maintain industrial base in oscillator and clock technology.
  - Developed low-noise, acceleration-insensitive oscillator technology for air-borne navigation and communication systems such as Joint Surveillance and Target Acquisition Radar System (JSTARS).
  - Developed low-power, high-accuracy clock technology to support direct P-code acquisition of global positioning system (GPS) as well as a high-shock version for GPS guided munitions.
- 3248 - Demonstrated laboratory prototype rechargeable lithium-ion battery with new low temperature electrolyte (joint with CECOM). This helps enable wider rechargeable battery use to reduce battery cost and logistic burden.
  - Developed laboratory prototype capacitor demonstrating new electrolyte.
  - Developed prototype monopolar cell stacks for small fuel cell for individual soldier applications.
- 5565 - Fabricated mercury cadmium telluride detector array on Si substrates.
  - Completed preliminary field demonstration of active and passive Multi Domain Smart Sensor (MDSS) concepts.
  - Completed literature survey of emerging magnetic sensor technologies and components and determined which are suitable for magnetic microsensors.
  - Demonstrated .8□micrometer quantum well modulator for laser radar (ladar).
  -Demonstrated remote temperature sensing using a two-color C-QWIP.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602705A Electronics and Electronic Devices
PROJECT AH94	

Total 17130

FY 1999 Planned Program:

- 7220 - Design and fabricate high frequency electronic components including antennas, ferroelectric materials/devices, transmit/receive modules, and MW/MMW devices to improve soldier situational awareness by enhancing the senses through communications, radar, electronic warfare (EW), surveillance, and target acquisition systems.
  - Demonstrate simulation models and new materials for power semiconductors and electromagnetic solvers for high frequency circuit design to reduce costs of high frequency electronic components.
  - Demonstrate technical performance of Ka Band Rotman lens with 34 element linear horn array with better than 3^{o} azimuth beam width.
  - Demonstrate 5W Ka Band power amplifier module.
- 2975 - Execute DoD-mandated program to support industrial base for research on low-noise, acceleration-insensitive oscillator technology and low-power, high-accuracy, high-shock clocks for communication/navigation systems.
- 2901 - Develop laboratory prototype capacitor with low equivalent series resistance (ESR) (new high conductivity electrolyte, improved electrode binder technology).
  - Develop prototype thermal battery with reduced thermal losses with 2x improvement in active life for smart munitions applications.
  - Demonstrate prototype hydrogen-PEM (proton exchange membrane) fuel cell with "strip-cell" design.
- 5627 - Demonstrate long wavelength infrared (LWIR) mercury cadmium detector array on Si substrates.
  - Demonstrate dual color quantum grid detector array for improved quantum efficiency and operating temperature.
  - Complete testing and analysis of ladar to demonstrate applicability to ARDEC submunition.
  - Demonstrate and deliver monolithic integrated semiconductor optical circuit to AMCOM for fiber gyro.

Total 18723

FY 2000 Planned Program:

- 3100 - Evaluate new acceleration insensitive clocks and oscillators using langasite and opto-electronic feedback.
- 8181 - Investigate novel resonator structures and electronic materials to improve filtering and control of RF signals to reduce Co-site interference.
  - Evaluate novel device structures, through modeling, that will provide improved low power operation for communications, high temperature operation for power conditioning, and sub-MMW performance for chemical agent classification.
  - Evaluate and select rf switch technology for multi beam switching Ka Band Rotman e-scan antenna.
  - Demonstrate performance of polarimetric W-Band active e-scan antenna.
- 6583 - Demonstrate dual color infrared focal plane array (IRFPA) grown directly on Si.
  - Complete scannerless eye-safe ladar and two color passive sensor and demonstrate as part of MDSS system.
  - Develop magnetometer-based sensor system for Army application.
- 3594 - Demonstrate lab prototype lithium-ion battery cell with new, more energetic anode & cathode materials, and more conductive electrolyte.
  - Demonstrate lab prototype methanol fuel cells with improved cathodic electrocatalyst and membrane electrolyte.

- Demonstrate lab prototype capacitors with new high voltage, low temperature electrolytes.

Total 21458

FY 2001 Planned Program:

- 5200 - Demonstrate factor of 5 improvement in acceleration insensitivity and phase noise through application of new materials and clock architectures.
- 8189 - Demonstrate cross bar switching control for Escan antennas to promote integration of target acquisition, combat ID, and communications in a common aperture.
  - Demonstrate new device structures for high power/efficiency and temperature operation through exploitation of novel semiconductors.
- 3671 - Develop laboratory prototype rechargeable lithium battery with all solid-state components for 3X improvement in energy density, enhanced safety for individual soldier applications.
  - Demonstrate prototype methanol fuel cell for system energy density 5X greater than batteries for long missions.
  - Develop miniature reserve batteries for smart munitions requiring long shelf life/long active life.
  - Develop prototype capacitors for battery/capacitor hybrids capable of full charge/discharge in minutes with energy densities >2X that of batteries.
- 6617 - Demonstrate large area dual color IRFPA with smart ROIC, improved storage capacity and optical readout.
  - Demonstrate feasibility of high temperature quantum grid or quantum dot detector array.
  - Develop reflection modulator that will conform to total ladar system design requirements.

Total 23677

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602705A Electronics and Electronic Devices

PROJECT: AJ04

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AJ04 Thermophotovoltaic Generator	1405	0	0	0	0	0	0	0	0	1405

Mission Description and Justification: This Congressional special interest project conducted applied research to enable newer, more advanced thermophotovoltaic (TPV) power sources. Prototypes of TPV power sources were developed and engineered as portable battery chargers operating on logistic fuels.

FY 1998 Accomplishments:

- 1405 - Completed investigation/identification of technology components (i.e. burners, filters, controls) enhancements to increase system efficiency and power output of a 500 Watt TPV power system prototype.
  - Completed testing/evaluation of a 200 W TPV power system prototype capable of operating on logistic fuels and recharging batteries for C4I2W applications.
  - Completed demonstration of a hydrocarbon fueled flash light for the individual soldier.

Total 1405

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology / PROJECT: DH95

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DH95 Night Vision and Electro-Optic Technology	16563	19008	20111	20966	21624	20527	21870	23436	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element (PE) develops core night vision and electronic sensor technologies for Army weapons systems. Advanced next generation focal plane arrays, both mega-pixel infrared and multispectral, are being developed that will see farther, provide advanced signal processing, and improve performance on the dirty battlefield. Advanced driver electronics are being developed to reduce power consumption and improve the contrast and brightness of miniature flat panel displays for future aviation, infantry, armored vehicle, and field maintenance applications. Multi-wavelength and micro-laser sources will provide affordable, high performance technology options for the individual soldier, and tactical laser rangefinding, designating, obstacle avoidance, laser radar, and missile countermeasures. Extended battlespace micro-sensors will provide a revolutionary increase in battlespace awareness that will improve soldier survivability, lethality, and situation awareness, and enable commanders and staffs to plan, decide, and execute operations with greater speed and tempo. Aided/automatic target recognition technologies will enable dramatic reductions in the time to acquire targets, detect land mines, and collect intelligence data while also reducing the warfighter's cognitive workload. Hardware-in-the-loop multispectral sensor simulations are being developed that will allow end-to-end predictive modeling, hardware design, and evaluation of new technologies in a virtual environment, while allowing warfighters to test these capabilities, develop tactics and techniques, and train in parallel with the hardware development process. This program element supports Force XXI Land Warrior, upgrades for Force XXI weapons systems, and Army After Next future systems. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri Service Reliance Agreements on Sensors and Electronic Devices. Work in this program element is related to and fully coordinated with PE 0602712A (Countermine Technology), PE 0602270A (Electronic Warfare Technology), and PE 0603710A (Night Vision Advanced Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

FY 1998 Accomplishments:

- 5001 – Evaluated the practicality and affordability of monolithic growth techniques for large single spectrum staring focal plane arrays that will improve focal plane performance, reliability, and manufacturing yield.
  – Developed validated staring imager performance models to support design and evaluation of advanced next generation staring sensors.
  – Demonstrated smart on-chip read-out circuit functions such as spatial and temporal filtering that can provide significant improvements in target to clutter contrast.
  – Evaluated multi-color large staring focal plane array technologies with hyperspectral filtering for overhead battlefield surveillance systems that will improve theater battlefield awareness and provide the capability to detect high value targets that are camouflaged or concealed. This is a joint program with Space and Missile Defense Command (SMDC).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology
	PROJECT: DH95

- 3096 – Evaluated and characterized uncooled focal plane array materials that are sensitive from the visible through near infrared spectral region and that can exploit the night time illumination effects of naturally occurring "sky-glow" radiation that is not detectable with current image intensifier technology.
  – Established sensitivity, resolution, and read-out circuit requirements for an uncooled, solid state near infrared imaging focal plane array to replace current generation image intensifier tubes.

FY 1998 Accomplishments: (continued)

- 1420 – Developed laboratory variable repetition rate laser pump module and combine with nonlinear conversion modules as needed for different applications such as target designation, eyesafe rangefinding, and laser radar.
- 4000 – Integrated advanced infrared and millimeter wave radar ATR evaluation capability for multi-sensor reconnaissance, search and target acquisition applications.
  – Incorporated low power consumption miniaturized high performance components into ATR processing hardware for compact sensor applications.
  – Developed synthetic aperture radar (SAR) automatic target recognition (ATR) evaluation methodology to characterize performance and support assessments of automation technologies.
  – Characterized synthetic FLIR imagery for ATR evaluation application.
- 3046 – Developed and integrated real-time multi-spectral effects (visible, near infrared, mid infrared) into synthetic scene generation capability to provide realistic sensor effects for sensor prototyping and wargame simulation and to reduce develop time.
  – Enhanced mine signature simulations for infrared and ground penetrating radar sensors and evaluation of aided mine detection algorithms in support of land mine center of excellence.

Total 16563

FY 1999 Planned Program:

- 4950 – Develop/design architecture for partitioning smart integrated circuit processing hardware functions between on- and off-focal plane to improve sensor performance and reduce processing hardware requirements for weapons platforms.
  – Design analog to digital conversion and multi-color fusion processing architectures for a monolithic infrared focal plane array read-out circuit.
  – Evaluate data throughput, heat dissipation, and circuit fabrication requirements for varying on-focal plane read-out circuit configurations with a goal of increasing read-out capacity by an order of magnitude.
  – Develop, evaluate, and refine fabrication processes for monolithic infrared focal plane arrays in experimental semiconductor microfactory, and transition successful processes to industry consortia members.
  – Enhance large multispectral staring focal plane array technology in support of SMDC's overhead sensor technology for battlefield awareness program.
- 2144 – Complete common source laser brassboard and demonstrate multiple functions in different wavelength bands.
  – Evaluate diode pumped laser source technology and investigate new high peak power laser diode structures for a micro eyesafe laser to reduce the size, weight, and power consumption of manportable laser devices.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology / PROJECT: DH95

- 4038 – Conduct ATR evaluations of multispectral and large format staring infrared sensors in increasingly complex dynamic operational scenarios.
  – Evaluate SAR ATR capability to include metrics to quantify improvements in situational awareness.
  – Develop mid wave IR staring sensor ATR evaluation capability.
  – Develop adaptable computing hardware to enable real-time ATR processing of multi-sensor data.

FY 1999 Planned Program: (continued)

- 3615 – Demonstrate a real-time multi-spectral (visible, mid infrared and far infrared) synthetic scene rendering capability in sensor prototyping and wargame simulations.
  – Enhance mine signature simulations that accurately represent multiple sensor spectrums and evaluate aided mine detection algorithms in support of land mine center of excellence.
  – Complete comparison between real and synthetic FLIR imagery for ATR evaluation applications.
  – Validate infrared sensor simulation.
- 3900 – Develop uncooled focal plane array device technologies for a low cost solid state near infrared camera that will be capable of day and night operation with sensitivity comparable to present image intensifier tube technology, and improve capability to detect camouflaged targets. Use fusion techniques to add long wave spectral region to provide enhanced driving capability.
  – Demonstrate microsensor uncooled infrared camera weighing less than 70 grams.
  – Develop electronics and image processing components necessary to integrate brassboard solid state, near infrared camera for multispectral imaging in visible and near infrared spectrums.
- 361 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 19008

FY 2000 Planned Program:

- 4700 – Develop 1024x1024 long wave infrared focal plane array for application to overhead sensor technology for battlefield awareness.
  – Develop and integrate analog to digital conversion circuitry on an infrared focal plane array to reduce read-out circuit noise and improve detector response to target or background temperature differences.
  – Develop and integrate non-uniformity correction circuitry on an infrared focal plane array that will calibrate all detector pixels to provide a uniform response to target or background temperature differences.
  – Test and characterize “P-type” detector material that will allow continuous, end-to-end fabrication of infrared focal plane in a closed semi-conductor environment. Successful development and implementation of this technology will reduced the number of fabrication steps, reduce impurities absorbed in the fabrication process that degrade performance, and lead to higher manufacturing yields.
  – Transition successful fabrication processes for monolithic infrared focal plane arrays to industry consortia members.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology / PROJECT: DH95

- 914 – Develop prototype fabrication processes for growing next generation, multi-spectral infrared detector arrays directly on a silicon semiconductor read-out circuit.
  – Develop and demonstrate the feasibility of an advanced "plasma etching" process that will enable fabrication of infrared focal plane arrays with smaller detector pixels. Smaller pixels will allow more arrays to be cut from a single detector wafer and provide improved sensor resolution.
- 4700 – Develop a breadboard, temperature stabilized uncooled near infrared camera.
  – Characterize the near infrared sensor's response to eyesafe laser illumination.
  – Collect target and background signature data with near infrared camera to support comprehensive characterization of reflectivity differences of typical "un-modified" targets, camouflaged targets, cultural background objects, and natural background materials.

FY 2000 Planned Program: (continued)

- 3807 – Develop advanced physics based performance, and search/target acquisition models needed to support next Generation FLIR engineering trade studies and operational utility assessments.
  – Develop a virtual engineering, prototyping and simulation environment to support design trade-offs, development, and evaluation of multi-function staring sensor suite, and mine hunter /killer advanced technology demonstrator programs.
  – Extend virtual prototyping and simulation development to support design and evaluation of advanced millimeter wave and synthetic aperture radar systems in order to evaluate adverse weather solution alternatives.
- 1250 – Demonstrate ATR processing architecture for space/volume constrained applications and platforms using adaptable computing technology.
  – Develop partitioning and software translation tools to allow system/hardware specific ATR software to be ported to different processing architectures.
  – Develop synthetic imagery and procedures needed to evaluate and quantify the performance of hyperspectral and multi-sensor mine detection ATRs.
- 1400 – Integrate IR imaging micro-sensors with acoustic and seismic micro-sensor to provide vastly increased threat distinguishing effectiveness of the micro-sensor node.
  – Demonstrate ultra-light, low power, low volume packaging concepts needed for compact, affordable sensor designs.
  – Develop self organizing network of IR micro-sensor arrays to enhance target detection capabilities, define communication links, and training requirements.
- 2100 – Develop low power, high brightness monochrome 1280x1024 flat panel displays and associated drive electronics for future insertion into high resolution, low power dismounted soldier applications.
  – Develop low power monochrome 640x 512 flat panel displays and transition to low power uncooled infrared sensor demonstration.
- 1000 – Develop ultra compact, diode pumped solid state, eyesafe, lasers which are low cost and provide 2 kilometer range performance.
  – Design and fabricate novel laser diode structures to improve peak power output by 5 times over commercial devices.
- 240 – Cooperative Eyesafe Laser Project (CELRAP) (Partner: Japan): Continue to develop a joint performance specification for a multifunctional, eyesafe laser radar for range finding, target profiling, obstacle avoidance, range and terrain mapping. Fabricate subsystems and brassboard.

Total 20111

FY 2001 Planned Program:

- 4825 – Develop and integrate "neuromorphic read-out" circuitry on an infrared focal plane array that will imitate the human eye capability to resolve and distinguish horizontal and vertical edges and to detect trace motion.
  – Develop and implement a prototype process for fabricating on focal plane micro-lens that will focus incident radiation on small pixel detectors and provide improvements in detector sensitivity and sensor performance.
  – Develop and test prototype advance lithography process that will reduce the number of fabrication steps for infrared focal plane arrays.
  – Transition successful lithography fabrication processes for monolithic infrared focal plane arrays to industry consortia members.

FY 2001 Planned Program: (continued)

- 1536 – Develop and test prototype process for semi-conductor microfactory fabrication of optical readout circuitry that will be required to simultaneously read-out the response from high speed, large area (640x480 and 1024x1024), dual color focal plane arrays. Limited capacity read-out circuits are a major technical barrier to higher performing next generation infrared devices.
  – Fabricate, test, and characterize next generation mid-wave and long-wave infrared focal plane array devices that provide high performance at elevated operating temperatures (120K vs current 77K).
- 4850 – Complete testing and evaluation of near infrared solid state cameras based on alternative detector materials, characterize performance, and define manufacturing yield issues for the alternative materials.
  – Define design parameters for a low cost, uncooled near infrared and far infrared sensor for dismounted soldier applications that provides a fused output of the two spectral bands to enhance the operator's perception of "color" contrast, shadows, and depth.
  – Transition technology to advanced development applications for the dismounted soldier, crew served weapons, and driver's vision aids.
- 3370 – Extend physics based performance and search /target acquisition constructive modeling to support additional sensor domains including radar, countermine, and multispectral sensors.
  – Validate multispectral models and simulations for target acquisition, driving, and pilotage applications, incorporate upgrades into virtual engineering prototyping and simulation environment in order to support new sensor concept evaluations and weapon systems trade studies and optimization.
- 1255 – Demonstrate an open "heterogeneous" ATR processor architecture that is capable of hosting ATR software/algorithms designed for unique or propriety hardware, thereby reducing the time and cost required to integrate ATR capability into new platforms.
  – Extend ATR evaluation capability to smart focal plane sensor systems.
- 1590 – Demonstrate small scale integrated network of acoustic, seismic, and imaging micro-sensors that will provide a significant unattended tactical sensing capability to detect, track, and classify time critical mobile and stationary targets.
  – Demonstrate low power consumption from micro-sensors and support electronics that will permit unattended micro-sensor operation for up to 60 days.
  – Perform experiments utilizing prototype micro-sensor nodes in various configurations to optimize warfighter effectiveness.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602709A Night Vision Technology / PROJECT: DH95

•	2200	– Develop full color 640 x 512 flat panel displays to allow dismounted soldiers to utilize color maps and symbology to enhance the soldier's performance. – Develop low power monochrome 1920 x 1080 flat panel displays to allow the soldier to display high resolution image formats (such as high definition TV and high resolution FLIRs) to support future high resolution imaging sensors.
•	240	– Cooperative Eyesafe Laser Project (CELRAP) (Partner: Japan): Continue to develop a joint performance specification for a multifunctional, eyesafe laser radar for range finding, target profiling, obstacle avoidance, range and terrain mapping. Fabricate subsystems and brassboard.
•	1100	– Complete development and evaluate micro diode pumped solid state laser devices and direct laser diode devices for performance, cost, weight, for rangefinder, munition ladars and other requirements.
Total	20966	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602709A Night Vision Technology

PROJECT: DH95

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	16712	19157	18796	19368
Appropriated Value	17304	19157		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-592	-149		
b. SBIR / STTR	-112			
c. Omnibus or Other Above Threshold Reductions	-37			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1315	+1598
Current Budget Submit (FY 2000/2001 PB)	16563	19008	20111	20966

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602712A Countermine Applied Research

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	9928	10547	10321	10453	10717	11008	11475	12044	Continuing	Continuing
AH24 Countermine Technology	8851	8168	8212	8031	8238	8468	8771	9208	Continuing	Continuing
AH35 Camouflage Technology	749	2028	2109	2422	2479	2540	2704	2836	Continuing	Continuing
AC61 AC61	328	351	0	0	0	0	0	0	0	1992

A. Mission Description and Budget Item Justification: This program element provides for countermine, electronic deception and advanced signature management technologies. The specific countermine efforts include close in detection of individual mines utilizing manportable technologies, detection and neutralization from moving vehicles, and remote detection of minefields. Advanced robotics technologies will be emphasized to minimize threats to weapons systems and personnel. Detection and neutralization techniques will be developed for both conventional and electronically activated mines. A Center of Excellence (CoE) for land mine detection will coordinate and standardize development of mine signature simulations, provide a catalogue of mine signatures, and support evaluation of mine detection algorithms. Electronic deception and advanced signature management techniques will provide combat units (e.g. Digital Tactical Operations Command, Small Unit Operations, Special Forces, Theater Missile Defense, Armored Systems) with an integrated system of electronic devises that deliberately alter the adversary's perception of friendly force capabilities and intentions. The Army has focused its resources and is expediting these programs in coordination with the US Marine Corps. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on conventional air/surface weapons and ground vehicles. Work in this program element is related to and fully coordinated with PE0602709A (Night Vision and Electro-Optics Technology), PE 0603606A (Countermine and Barrier Development), and PE0603710A (Night Vision Advanced Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602712A Countermine Applied Research

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	10272	10715	10485	10574
Appropriated Value	10598	10715		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-326	-168		
b. SBIR / STTR	-257			
c. Omnibus or Other Above Threshold Reductions	-87			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-164	-121
Current Budget Submit (FY 2000 / 2001 PB)	9928	10547	10321	10453

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602712A Countermine Applied Research / PROJECT: AH24

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH24 Countermine Technology	8851	8168	8212	8031	8238	8468	8771	9208	Continuing	Continuing

A. Mission Description and Justification: Countermine research will focus on remote detection of minefields and detection and neutralization of individual mines from vehicular and man portable platforms. Neutralization techniques will be developed for both conventional and electronically activated mines that can be detected and neutralized at a standoff distance. Will develop and utilize data collection platforms for continual sensor and algorithm phenomenology assessments as mine detection technologies. Mine detection and neutralization technologies and techniques will provide enhancements addressing improved probability of detection, reduction in false alarms and improved operational tempo. A COE for land mine detection will coordinate and standardize development of mine signature simulations, provide a catalogue of mine signatures, and support evaluation of mine detection algorithms.

FY 1998 Accomplishments:

- 750 – Investigated a variety of new component and focal plane array (FPA) technologies, such as 3-5 micron staring FPAs, multi/hyperspectral, passive polarization, active sources and electronic stabilization to support a lightweight, airborne standoff mine detection capability.
- 4864 – Evaluated alternative precision neutralizer devices in cooperation with the Armaments Research, Development, and Engineering Center. Eliminated direct-fire cannon technology as viable alternative. Redirected neutralization technologies toward point neutralizers to be deployed by remote delivery techniques.
  – Down-selected sensor technologies developed under the vehicular mounted mine detector program for application to the mine hunter/killer.
  – Established sensor fusion/automatic target recognition (ATR) processing procedures and techniques to improve detection performance while reducing occurrence of false alarms.
  – Developed and evaluated initial forward-looking mine detection technologies for implementation to providing standoff detection capabilities.
- 1750 – Evaluated advanced infrared (IR), ultra-wide band ground penetrating radar, acoustic, electromagnetic induction eddy current analysis, passive microwave, magnetoresistive, microbial/bioluminescent detection technologies to significantly improve detection capability and increase probability of detection and reduction of false alarms against antipersonnel (AP) and antitank (AT) mines.
- 1487 – Developed mine signature simulations, populated database with mine signatures, and established methodology for evaluation of detection algorithms in support of land mine detection COE.

Total 8851

FY 1999 Planned Program:

- 1400 – Complete design and performance trade-off analysis and evaluation of alternative multispectral imaging sensor technologies for a lightweight airborne minefield detection capability.
  – Develop and test critical component modules for the lightweight airborne mine detection sensor.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602712A Countermine Applied Research
	PROJECT: AH24

- Collect mine signature data to support finalization of phenomenology studies and mine detection algorithm development.

FY 1999 Planned Program: (continued)

- 4659 – Develop and evaluate the fundamental phenomenology for advanced mine detection sensor technologies.
  – Complete test and evaluation of alternative neutralization technologies and down select to most effective approach.
  – Evaluate preliminary development of advanced sensor fusion/ATR processing and integrate with vehicle mounted mine detector sensors.
  – Develop and evaluate the fundamental phenomenology for forward-looking mine detection technologies.
- 1500 – Complete preliminary research on eddy current decay analysis techniques to reduce false alarms and provide detection and classification capabilities for surface and buried metallic mines.
  – Asses high dynamic range radar, giant magneto-resistive arrays, and acoustic mine detection techniques capabilities to improve detection performance of hand-held and vehicular mounted mine detectors.
- 484 – Enhance mine signature simulations, cataloguing of mine signatures, and assessments of mine detection algorithms in support of land mine detection COE.
- 125 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 8168

FY 2000 Planned Program:

- 1480 – Design mine phenomenology data collections that will support the defining of hyperspectral sensor approaches for airborne mine detection implementation.
  – Evaluate airborne multispectral and hyperspectral testbed sensor data and supporting ground truth with the goal of defining conditions and observable phenomena to optimize the multi-sensor fusion approach.
- 1877 – Conduct phenomenology study to evaluate existing DARPA, NVESD and other technologies and techniques and benchmark through field experiments.
  – Setup standards and techniques for evaluation of these confirmation technologies at various test sites.
- 1880 – Evaluate and assess the advanced mine detection sensors by down selecting to the most promising technologies and techniques. Collect and analyze data to evaluate improvements in probability of detection and reduction of false alarm rates.
  – Complete design and trade off analyses of a acoustic laser Doppler vibrometer breadboard prototype to determine system parameters for detecting mines at greater standoff distances with possible application into the forward looking or confirmation technology areas.
  – Evaluate industry/academia concepts and technologies with potential to increase probability of detection, reduce false alarms or increase standoff distances as means to enhance force mobility and survivability.
- 500 – Enhance mine signature simulations, update database of mine signatures, and established methodology for evaluation of detection algorithms in support of land mine detection COE.
- 2475 – Evaluate forward looking detection sensor designs (GPR and IR) through testing in temperate environments of surface and buried AT mines with the goal of demonstrating improved probability of detection and reduced false alarm rates for on and off route mission scenarios.

– Evaluate forward looking detection sensor technologies with the goal of improved probability of detection and reduced false alarm rates while increasing operational speed.

FY 2000 Planned Program: (continued)

- Transition technologies into data collection devices for continual evaluation and assessment of sensors and algorithms.

Total 8212

FY 2001 Planned Program:

- 2781 – Complete development and fabrication of explosive specific confirmatory sensor brassboard prototypes for field experiments and evaluation.
  – Complete field experiments using realistic explosive concentrations to establish the prototype's operational envelopes as a function of target type, environment, and operational speed.
  – Complete maturation of higher risk technologies from DARPA's chemical detection program and select the most promising approach that yields lower false alarm rates and faster operational speeds.
- 1775 – Evaluate potential of acoustic advanced mine detection sensors for inclusion in on going downward and forward looking mine detection programs as primary detection sensor.
  – Complete proof of concept experiments for new technologies and transition successful advanced mine detection technologies for future insertion into mine detection systems.
- 500 – Enhance mine signature simulations, update database of mine signatures, and establish methodology for evaluation of detection algorithms in support of land mine detection COE.
- 2975 – Evaluate brassboard forward looking detection systems for detection of surface and buried AT mines that will improve probability of detection and reduce false alarms.
  – Evaluate initial ATR and sensor fusion algorithms for forward looking detection sensors, which will improve the probability of detection and reduce false alarm rates, while increasing operational speeds.

Total 8031

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602712A Countermine Applied Research PROJECT AH35

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH35 Camouflage Technology	749	2028	2109	2422	2479	2540	2704	2836	Continuing	Continuing

A. Mission Description and Justification: Develop electronic deception and advanced signature management technologies that alter the threat perception of friendly force capabilities and intentions and deny acquisition of friendly force assets from threat sensors. Demonstrations will be supported by spectrum characterization, modeling and simulation conducted under the integrated sensor modeling and simulation effort, situation awareness sensors through warrior extended battlespace sensor effort, and hyperspectral sensor development efforts. These deception systems provide combat units with capability to camouflage friendly assets and project a deceptive image of friendly forces, thereby improving survivability of combat units in global battlefield conditions.

FY 1998 Accomplishments:

- 749 – Completed feasibility studies for advanced camouflage and deception technologies using holography and digital radio frequency memory (DRFM) technologies.

Total 749

FY 1999 Planned Program:

- 1985 – Develop holographic techniques, materials, and processes to support development of visual and infrared deception system modules.
  – Evaluate DRFM technologies feasibility to support development of radar deception system module.
  – Complete feasibility studies including evaluation of communications, situation awareness sensors, and projection technologies required for an integrated modular electronic deception system (IMEDS).
  – Design modeling and simulation efforts to support design and evaluation of concepts, systems, and operational effectiveness for electronic deception systems.
- 43 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2028

FY 2000 Planned Program:

- 2109 – Evaluate holographic techniques, materials, and processes for visual and infrared deception devices.
  – Design, model and simulate architecture for the IMEDS
  – Develop technologies to support the development of deception modules for radar, acoustic, seismic, and communication band deception modules for the IMEDS
  – Demonstrate radar and communications capabilities for IMEDS modules.

Total 2109

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602712A Countermine Applied Research
PROJECT AH35	

FY 2001 Planned Program:

•	2422	– Demonstrate holographic techniques for improved deception capabilities for combat units. – Evaluate IMEDS architecture for situational awareness and project technology capabilities. – Demonstrate techniques that combine physical and electronic decoys with signature management technologies to improve survivability of combat and combat support units.
Total	2422	

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: **2 - Applied Research**

PE NUMBER AND TITLE: **0602716A Human Factors Engineering Technology**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	16577	16473	16392	16270	17274	16657	16924	17746	Continuing	Continuing
AH34 Rural Health Technology	2810	3228	0	0	0	0	0	0	0	5522
AH70 Human Factors Engineering Systems Development	13767	13245	16392	16270	17274	16657	16924	17746	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objectives of this program are, first, to maximize the effectiveness of soldiers in concert with their materiel so that they may survive and prevail on the battlefield. 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. Secondly, this program focuses on the development, field testing, and empirical validation of methods for improving the coordinated functioning of civilian and military emergency medical teams. The work in this latter effort complements related Army programs in soldier performance, training and evaluation methodologies, and will provide direct research benefits to the Army's medical community, including combat casualty care on the battlefield and in other remote areas of operation. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. All work under this PE is part of the Human Systems Tri-Service Reliance panel.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	16723	13369	14193	14396
Appropriated Value	17256	16619		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-533	-146		
b. SBIR / STTR	-110			
c. Omnibus or Other Above Threshold Reductions	-36			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+2199	+1874
Current Budget Submit (FY 2000 / 2001 PB)	16577	16473	16392	16270

Change Summary Explanation: Funding – FY 1999 – Congressional increase for Rural Health Technology (+3250)
FY 2000 (+2199) and FY 2001 (+1286) to support research in cognitive engineering and transition products from the Advanced and Interactive Displays Federated Lab.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602716A Human Factors Engineering Technology / PROJECT: AH34

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH34 Rural Health Technology	2810	3228	0	0	0	0	0	0	0	5522

Mission Description and Justification: This is a congressionally funded program; not part of the Army's core mission funded program. The Medical Teams program provides for the continued development, field testing, and empirical validation of methods for improving the coordinated functioning of emergency medical teams (both military and civilian). This project, initially supported by Congress in FY96, extends previous Army research on the effective training and evaluation of military aviation crews and systematically applies it to the collection of hospital and pre-hospital personnel who must perform as an effective team during the initial "golden hour" of shock/trauma or acute patient care. Additionally, this project provides both the civilian and military medical communities with a rigorous framework for objectively demonstrating and assessing the "value-added" of selected telemedicine and medical decision management technologies.

FY 1998 Accomplishments:

•	2810	- Completed evaluation of the prototype hospital training and evaluation system at each of the cooperating hospitals. - Completed an extended team testbed at Madison Army Medical Center. - Completed a test of an advanced intra-team communication system at Madison Army Medical Center and Rhode Island Hospital.
Total	2810	

FY 1999 Planned Program:

•	3142	- Complete the evaluation of the MedTeams training and evaluation system at each of the cooperating hospitals selected in Phase I. - Conduct an extended team test bed at Madigan Army Medical Center. - Conduct a test of an advanced intra-team communication system at Madigan Army Medical Center and Rhode Island Hospital. - Develop, in conjunction with University of Maryland Shock Trauma Center, an improved protocol for field-to-hospital communications. - Introduce MedTeams research products to civilian and emergency care facilities at selected locations in CONUS. - Execute concept development for MedTeams combat casualty care with the cooperation of Army, Navy and Air Force participating hospitals.
•	86	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	3228	

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602716A Human Factors Engineering Technology**
	PROJECT **AH70**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH70 Human Factors Engineering Systems Development	13767	13245	16392	16270	17274	16657	16924	17746	Continuing	Continuing

Mission Description and Justification: This program focuses on maximizing the effectiveness of the soldier in concert with his materiel, in order to survive and prevail on the battlefield. 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.

FY 1998 Accomplishments:

- 4787 -Extended collaborative planning tools to logistics planning, preparation and execution at all echelons. Transitioned software-based tools to Combined Arms Support Command (CASCOM).
  - Investigated control and operator sensing strategies and configurations for teleoperated manipulator devices performing military tasks. Developed baseline operator workload models for unmanned ground vehicles. Transitioned data to the Program Manager for Unmanned Ground Vehicles (PM UGV) and U.S. Army Aviation and Missile Command (AMCOM).
  -Published findings on sensor human feedback devices and exoskeleton control devices. Transitioned data and guidelines to Natick RDEC, Soldier Systems Command (SSCOM), and the Infantry School.
  - Accomplished verification and validation of the auditory detection model. Conducted a study to assess the impact of multi-directional auditory displays on crew performance in armored vehicles for TARDEC.
  -Conducted cognitive analysis of command, control, communications, computers and intelligence (C4I) systems and developed models to assess system effects on decision making and the ways soldiers visualize military operations for the Battle Command Battlelab.
- 3987 - Developed unique features and refinements for the human figure performance model (JACK) with emphasis on improving run-time, user interface and fidelity and decreasing the time and cost to use critical features.
  -Completed Improved Performance Research Integration Tool (IMPRINT), Version 3, which incorporates embedded analysis wizard, advanced workload analysis capability, and updated resident databases for use in soldier-system front end analyses.
  -Refined the virtual reality capability for the individual soldier fighting systems in a DIS environment; integrated the sensor suit (which records the movements of humans engaged in strenuous exercise) and a low to medium resolution version of the soldier icon (JACK); initiated collection of baseline data for live and virtual studies. Transitioned data and design guidelines to Simulation, Training and Instrumentation Command (STRICOM).
- 4993 - Developed soldier-system analysis and tradeoff tools and workload models for assessing soldier and unit performance and the life cycle cost implications of choices in concept and system designs.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602716A Human Factors Engineering Technology PROJECT AH70

FY 1998 Accomplishments: (Continued)

-Provided HFE support to AMC, AMC RDECs, TRADOC activities, battle labs, and other laboratories.
-Developed an integrated set of soldier-information system performance based design standards and demonstrated in Division AWE.

Total 13767

FY 1999 Planned Program:

- 4482 -Enhance existing logistics data analysis capabilities to serve logisticians at appropriate echelons.
- Refine operator workload models for unmanned ground vehicles.
-Investigate the impact of multi-directional auditory displays on helicopter pilot performance. Publish results and provide to the Aviation School and Aviation and Missile Command.
-Develop a human performance measurement strategy to assess new command and control concepts in the distributed interactive simulation (DIS) environment.
- Identify, in terms of soldier performance, how the application of 2-D and 3-D visualization concepts impacts the battle staff's task domain. Identify and quantify which advanced visualization concepts enhance or detract from staff performance and how they support collaborative planning and problem solving by a geographically dispersed staff.
- 3997 -Verify and validate the human figure performance model (Jack), link with physics based model, and begin to incorporate data collected in 3-D.
-Add training requirements analysis capability and enhanced performance degradation modeling to Improved Performance Research Integration Tool (IMPRINT) Version 3.
- Collect performance data using the virtual reality capability for the individual soldier fighting systems in a DIS environment, compare results of live and virtual studies, and update and validate the databases with actual research data. Transition data and guidelines to STRICOM.
- 4649 -Refine soldier system analysis and tradeoff tools and workload models for assessing soldier and unit performance and the life cycle and cost implications in concept and system designs. Enhance human factors engineering field evaluation methods with soldier in the loop operational test data to upgrade existing capabilities to assess new technologies and systems.
-Provide HFE support to AMC, AMC RDECs, TRADOC activities, battle labs, and other laboratories.
- 117 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 13245

FY 2000 Planned Program:

- 4956 - Enhance logistic planning tools to enable warfighting analysis of enemy logistics capabilities and vulnerabilities.
- Develop a baseline model of current unit level vehicle maintenance operations for use in assessing soldier performance and organizational design. Transition methods to the Ordnance Center and School.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602716A Human Factors Engineering Technology PROJECT AH70

- Conduct studies to investigate the relationship between human sensory capabilities and vehicle control requirements for both on-board and teleoperated systems. Transition data to PM UGV, Aviation and Missile Command, and TARDEC.

FY 2000 Planned Program: (continued)

- Conduct field study to determine the effect of advanced display technologies, e.g. 3-D audio, speech recognition and active noise reduction on dismounted soldier task performance under different levels of physical and mental workload.
- In collaboration with Natick Research Development and Engineering Center (NRDEC) and the Infantry School, define a dismounted soldier baseline day for use as an R&D standard scenario.

•	3593	Refine and validate the command and control human performance measurement study in the DIS environment for use in evaluating system concepts in relationship to individual, collective and teamwork requirements. Transition methods and techniques to the Battle Command Battle Laboratory and the Depth and Simultaneous Attack Battle Laboratory. - Perform soldier focused assessments of various battlefield reasoning and multi-modal display systems to support the commander and staff's ability to use intelligent algorithms to produce end states, generate courses of action and maintain situation awareness related to enemy as well as friendly forces. - Develop a set of predictive models and performance metrics for cognitive re-engineering of the battle command process. A refined process model of command and control planning and execution decision making for integrated battalion through Corps will be developed. Behavior based metrics for assessing commander and staff performance with digitized systems will be evaluated in Army Capstone exercises. - Complete development of a rule-based computer model of the intelligence production system which simulates how the quality of information in military intelligence databases and the soldier's ability to use that information will meet commander and staff military intelligence requirements.
•	5643	- Enhance the human figure performance model to include development of fully scaleable, smooth contoured human body model; fast, dynamic variable thickness clothing model; and high fidelity hand model. - Add the capability to model performance under stress to the Improved Performance Research Integration Tool (IMPRINT) and demonstrate links to advanced distribution simulation. - Collect human performance data and develop kinematics and dynamic mobility models and simulations to support further development of control methodology and algorithms for the virtual reality (VR) capability for the dismounted soldier. Provide guidelines to STRICOM. - Conduct enhanced HFE field evaluations with solider-in-the-loop operational test data to upgrade existing capabilities to assess new technologies and systems. - Provide HFE support to AMC, AMC RDECs, TRADOC Centers, Schools and Battle Laboratories and other laboratories.
	2200	- Leverage Strike Force planning and experimentation to address critical training, leader development and soldier support (TLS) research issues in the cognitive engineering of battle command operations. Facilitate transition of research products from the Advanced & Interactive Displays Fed Lab into the experimental process.
Total	16392	

FY 2001 Planned Program:

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602716A Human Factors Engineering Technology
	PROJECT AH70

- 5184 - Develop automated measurement tools that enable a common relevant basis for viewing, analyzing and assessing sustainment capability and responding to a wide variety of logistics issues across echelons. Develop an ammunition configuration process simulation for assessing various loads.
  Transition tools and techniques to CASCOM and PM Ammolog.

FY 2001 Planned Program: (continued)

- Develop and evaluate prototype tools and maintenance aids to reduce soldier workload in the conduct of vehicle service tasks. Transition to PM Test, Measurement, and Diagnostic Equipment (TMDE)
- Publish results of previous studies on human sensory capabilities and operator performance. Develop and refine a comprehensive model of human operator performance for both on-board and teleoperated systems.
- Translate research results on the effects of advanced audio display technologies on dismounted soldier tasks performance into design guidelines for use by NRDEC, the Infantry School and Dismounted Battlespace Battle Lab.
- Complete development of the dismounted soldier baseline day for use in evaluating soldier equipment interface and compatibility. Transition to NRDEC and the Infantry School.

- 3858 - Publish technical report on the previously developed command and control performance measurement strategy and apply to system test and evaluation activities.
  - Perform realistic simulation experiments and soldier focused investigations evaluating concepts for multi-modal presentations. Concepts and general human visualization guidelines will transition to Intelligence and Security Command (INSCOM), Army Battle Command System (ABCS), Communications-Electronics RDEC, Battlefield Visualization ATD, Battle Command Battle Lab, and Intelligence Center and Fort Huachuca.
  - Develop refined battle command technology integration requirements for advanced Battle Force unit design (including operations other than war). Begin efforts to translate battle command process models into constructive simulation software.
  -Validate the intelligence production model (IPM) in intelligence field units at varying command levels.

- 5942 - Complete the incorporation of three dimensional laser body scan data into the fully interactive human figure model. Make latest version available to users for application to system design.
  - Provide a unit level modeling capability in IMPRINT for assessment of Force XXI and AAN manning concepts. Develop and validate an approach for predictive modeling of the team behavior component of system performance.
  - Conduct an investigation of the integrated system behavior between the mobility interface device and the control systems for the dismounted soldier combatant simulation. Transition results to STRICOM and the Army Research Institute (ARI).
  - Conduct enhanced HFE field evaluations with soldier in the loop operational test data to upgrade existing capabilities to assess new technologies and systems.
  - Provide HFE support to AMC, AMC RDECs, TRADOC Centers, Schools and Battle Laboratories and other laboratories.

- 1286 - Leverage Strike Force planning and experimentation to address critical training, leader development and soldier support (TLS) research issues in the cognitive engineering of battle command operations. Facilitate transition of research products from the Advanced & Interactive Displays Fed Lab into the experimental process.

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602716A Human Factors Engineering Technology**

Total 16270

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

	COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	58711	64386	12758	14041	14308	14912	17988	19569	Continuing	Continuing
D048	Industrial Operations Pollution Control Technology	2324	2362	2184	2384	2541	2705	3264	3469	Continuing	Continuing
A821	Bioremediation Education Science and Technology (BEST) Centers	3747	0	0	0	0	0	0	0	0	3747
A822	Facility Environmental Mangement and Monitoring System	4683	1987	0	0	0	0	0	0	0	6670
A823	Hawaii Small Business Development Center	5059	3973	0	0	0	0	0	0	0	9032
A829	National Defense Center for Environmental Excellence (NDCEE) Technology	8940	14901	0	0	0	0	0	0	0	23841
A835	Military Medical Environmental Criteria	3506	3134	2426	2865	2927	3098	3374	3778	Continuing	Continuing
A876	Plasma Energy Pyrolysis System	5621	2980	0	0	0	0	0	0	0	8601
A877	Western Environmental Technology Office Environmental Support	6558	3974	0	0	0	0	0	0	0	10532
A895	Pollution Prevention Technology	0	609	0	0	0	0	1551	2190	Continuing	Continuing
A896	Base Facility Environmental Quality	2973	4294	4676	5196	5144	5299	5722	5858	Continuing	Continuing
A908	Commercialization of Technology to Reduce Defense Costs Initiative	4683	5961	0	0	0	0	0	0	0	10644
A917	Computer Based Land Management	3747	2484	0	0	0	0	0	0	0	6231
A946	Electronic Equipment Demanufacturing	0	5960	0	0	0	0	0	0	0	5960

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A947 Sustainable Green Manufacturing	0	2980	0	0	0	0	0	0	0	2980
AF25 Military Environmental Restoration Technology	3123	3323	3472	3596	3696	3810	4077	4274	Continuing	Continuing
AF26 Agricultural-Based Bioremediation	3747	3974	0	0	0	0	0	0	0	7721
AF27 ARO Chemical/Hazardous Material Disposal	0	1490	0	0	0	0	0	0	0	1490

A. Mission Description and Budget Item Justification: This Program Element (PE) provides technology that allows the Army to comply with regulations mandated by all Federal, State and local environmental/health laws and to reduce the cost of this compliance. Examples of key laws include the Superfund Amendments and Reauthorization Act of 1986 and the Defense Environmental Restoration Act (the DoD equivalent of this law), in addition to the Resource Conservation and Recovery Act of 1984, as amended. This PE provides 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. The current DoD estimate for the total Army cost of completing this cleanup program is eight to ten billion dollars. This PE also provides 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 PE develops pollution control technology, which assists installations to comply with environmental regulations at less cost. The PE also provides technology to mitigate noise impacts and maneuver area damage resulting from Army training activities. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, 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.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	56131	13842	14617	15706
Appropriated Value	61919	64842		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1788	-456		
b. SBIR / STTR	-1279			
c. Omnibus or Other Above Threshold Reductions	-419			
d. Below Threshold Reprogramming	+278			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-1859	-1665
Current Budget Submit (FY 2000/2001 PB)	58711	64386	12758	14041

Change Summary Explanation: Funding - FY 1999 – Congressional increase to program (+51000).
FY2000/2001 - funds reprogrammed for higher priority requirements (FY00 –1859/FY01 –1665).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology / PROJECT: D048

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D048 Industrial Operations Pollution Control Technology	2324	2362	2184	2384	2541	2705	3264	3469	Continuing	Continuing

Mission Description and Justification: This project provides pollution control technologies required to reduce the cost of treating hazardous toxic effluent from the operation of Army industrial installations, which include ammunition plants, depots and arsenals, and to satisfy increasingly stringent wastewater discharge standards under the Clean Water Act and relevant state regulations. Federal facilities are now subject to fines and facility shutdowns for violation of federal, state, and local air and wastewater discharge regulations. This new technology is essential to control and reduce generation of hazardous waste, to satisfy hazardous waste reduction goals and to avoid future hazardous waste disposal costs and liabilities to the Army. This project will provide compliance tools to control toxic air pollutants regulated under the Clean Air Act amendments. Efforts will focus on new energetic materials, which will enter the Army inventory within the next decade to assure that ammunition plants will remain compliant. Changes in solid, liquid, and gaseous emissions resulting from pollution prevention efforts will require technology changes to existing treatment systems to compensate. The primary developing agency is the U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

FY 1998 Accomplishments:

- 2324 - Developed adaptive tuning control algorithms for industrial wastewater treatment plant automation.
  - Developed biofilter technology for treatment of volatile organic compounds (VOC) from industrial operations.
  - Developed improved biological treatment technologies for energetic wastewater employing sulfate reduction environments.
  - Developed engineered gelatin technology for stabilization of industrial waste streams contaminated with heavy metals.
  - Developed technology to permit safe demolition of buildings at ammunition plants which are contaminated with energetics, asbestos, lead and other hazards.

Total 2324

FY 1999 Planned Program:

- 2350 - Develop technology for electrochemical reduction of energetic compounds in water.
  - Develop biological treatment technology for munitions production using sulfate-reducing bacteria.
  - Develop thermal plasma techniques for the pyrolytic destruction of organic energetic wastes and the vitrification of heavy metal-bearing wastes.
- 12 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2362

FY 2000 Planned Program:

- 2184 - Develop biofilter technology criteria for treating mixed air streams.
  - Develop technology for electrochemical reduction of energetic compounds in water.

Total 2184

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology
	PROJECT: D048

FY 2001 Planned Program:

•	2384	- Develop sonolytic and catalytic photolysis for energetic wastes treatment.
		- Complete biofilter technology development for controlling munitions production VOCs.
		- Develop biological treatment technology development for munitions wastewater under sulfate-reducing conditions.
Total	2384	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology / PROJECT: A821

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A821 Bioremediation Education Science and Technology (BEST) Centers	3747	0	0	0	0	0	0	0	0	3747

Mission Description and Justification: Funds for this project were provided by Congress in FY98. Work will be completed in FY00 using only the FY98 funds. Bioremediation Education, Science and Technology Centers (BEST) have been developed to address research needs of bioremediation through a partnership between a major university, a national laboratory, and a science consortium located at a historically black college or university (HBCU). The goals for the centers established under this program are to become a national resource for multidisciplinary research and education in bioremediation sciences. In FY93, the Department of the Army was appropriated funds to establish BEST Centers. The U.S. Army Corps of Engineers (USACE) was assigned as the Army's executive agent for administering the BEST Program. The U.S. Army Engineer Waterways Experiment Station (WES) administers the BEST Program for the USACE. WES, through a Broad Agency Announcement (BAA) process, awarded a three-year cooperative agreement for operation of a BEST Center to: The Regents of the University of California, Lawrence Berkeley Laboratory (LBL). The LBL was awarded the BAA for establishment of a BEST Center under Cooperative Agreement Number DACA39-95-2-0005. The BEST Center consists of the University of California Lawrence Berkeley Laboratory (LBL); Jackson State University (JSU), Jackson, MS; and the Ana G. Mendez University System (AGMUS), San Juan, Puerto Rico.

FY 1998 Accomplishments:

- 3747 - Established MS, BS, and Ph.D. programs in environmental science, biology, and microbiology, a Rotating Scholars program, and a BEST Seminar Program.
  - Delivered high school teacher and middle school summer bioremediation science workshops; organized a K-12 bioremediation science fair; established BEST education program for 64 undergraduate, 21 graduate, and 4 post-doctoral participants; and established BEST Web site, student web pages and a web-based graduate bioremediation course.
  - Developed an in-situ stable isotope monitoring system for petroleum hydrocarbon degradation at DoD site, a microbial community monitoring system for industrial activated sludge hydrocarbon and metal treatment, an in-situ x-ray and Gamma-ray spectroscopy for speciating toxic metals, and determined microbial community diversity for various toxic metal impacted environments producing BEST presentations at 72 scientific meetings and 37 peer-reviewed journal articles by BEST student and faculty.

Total 3747

FY 1999 Planned Program: Program not funded in FY 1999.

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A822

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A822 Facility Environmental Mangement and Monitoring System	4683	1987	0	0	0	0	0	0	0	6670

Mission Description and Justification: Funds for this project were provided by Congress in FY98 and FY99. Based on technology demonstrated at Tobyhanna Army Depot (TYAD) under the Facility Environment Management and Monitoring System (FEMMS), the technology will be transferred to the Radford Army Ammunition Plant (RFAAP) as the basis for REDMAP. This Congressionally mandated pollution prevention project is managed by the Army to institute the Radford Environmental Development and Management Program (REDMAP) at the Radford Army Ammunition Plant, Virginia for the development of an integrated environmental and pollution prevention (P2) management and control system. In addition, since all DoD facilities are required to implement Executive Order (E.O.) 12856 by 1999 (so that Federal facilities comply with the mandated Pollution Prevention Act (PPA) of 1990 and Executive Order 12856 of August 3, 1993), these funds will focus on issues related to implementation of E.O. 12856 at RFAAP.

FY 1998 Accomplishments:

- 220 - Initiated program development. During FY98:
  Performed baseline site review of RFAAP for FEMMS modules and P2 projects.
  Finalized list of FEMMS modules and projects for RFAAP.
  Began design of Environmental Information System and Air Modeling FEMMS Modules for RFAAP.
- 4463 - Evaluated pollution prevention technologies to: replace/reduce sodium hydroxide as a cleaning agent, reduce sulfates at an RFAAP acid-screen house, and reuse/recycle/separate nitrocellulose replacement materials for clay pan liners used in open burning.
  - Implemented environmental management projects in: Environmental Information System, Air Dispersion Modeling/Emergency Response System, Virginia Pollutant Discharge Elimination System Monitoring and Control System, Selective Catalytic Reduction/Molecular Sieve Control Upgrade, and Propellant Explosive Pyrotechnic Tracking System.

Total 4683

FY 1999 Planned Program:

- 1934 - Complete the remaining FEMMS Modules: Electrostatic Precipitator (ESP), Propellant Explosive Pyrotechnic (PEP) Tracking System, Virginia Pollutant Discharge Elimination System (VPDES, i.e., Wet Wells and Outfalls), and integrate modules into the Environmental Information System (EIS).
  - Complete high priority environmental management projects which had high implementation savings potential (e.g., reduction of sulfates). Also, complete requirements and alternatives analysis on a new set of environmental projects and implement highest priority, highest payback options - (e.g., recycle/reuse of energetic manufacturing process fluids, aqueous-based and acidic-based streams).
- 53 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A Environmental Quality Technology
	PROJECT A822

Total 1987

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A823

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A823 Hawaii Small Business Development Center	5059	3973	0	0	0	0	0	0	0	9032

Mission Description and Justification: This Congressionally-mandated project is a continuation of an effort begun in FY 93 under project A830. Funds for this project were provided by Congress in FY98 and FY99. The project has technology policy goals favoring activities that meet dual-use and employment-creating criteria. The former refers to commercializing products that are used by Armed Services personnel as well as the civilian population. The latter is offered as a contribution to U.S. economic revitalization. The approach involves private-public partnerships to carry out activities leading to the commercialization of these products. These include but are not limited to pharmaceuticals, industrial products, and food products derived from the agricultural resources of transitioning sugar plantations in Hawaii. Advisory personnel from federal agencies (primarily the Departments of Defense and Agriculture) and state agencies participate at the work group and oversight committee levels.

FY 1998 Accomplishments:

- 5059 - Developed agricultural-industrial products having potential for dual-use and commercialization, focusing on native Hawaiian agricultural crops with potential application for medicine/food/bioremediation use in the military.

Total 5059

FY 1999 Planned Program:

- 3868 - Complete the development of agricultural industrial products having potential for dual-use and commercialization, focusing on native Hawaiian agricultural crops with potential for medicine/food/bioremediation use in the military.
- 105 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3973

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A829

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A829 National Defense Center for Environmental Excellence (NDCEE) Technology	8940	14901	0	0	0	0	0	0	0	23841

Mission Description and Justification: This Congressionally mandated project is managed by the Army on behalf of the Office of the Deputy Undersecretary of Defense for Environmental Security (DUSD-ES). The mission of the NDCEE is four-fold: (1) Demonstrate and export new environmentally-acceptable technology to the industrial base; (2) train the industrial base on the use of the new technology; (3) perform research and development, where necessary, to mature a new technology prior to demonstrating and exporting the new technology to the industrial base and (4) assist DoD in technology transfer. The NDCEE, which is located in Johnstown, Pennsylvania, has the goal of resolving the environmental technology and management requirements of the DoD community and commercial industrial base. The primary in-house development agency is the U.S. Army Materiel Command's Armament Research, Development, and Engineering Center, Picatinny Arsenal, NJ. The NDCEE has positioned itself as a critical resource for the Deputy Undersecretary of Defense for Environmental Security for environmental management and technology validation and integration. Major programs support by the center include the Joint Group on Acquisition Pollution Prevention, Toxins Reduction Investment and Management (TRIM), environmental cost accounting standards development and the DoD fuel cell program. Agreements have been signed with Air Force Center for Environmental Excellence and U.S. Army Center for Health Promotion and Preventive Medicine, 4 EPA Offices, 2 Department of Energy Offices, the Navy Facilities Engineering Service Center, and the Federal Laboratory Consortium. This project transferred to PE 0708045A beginning in FY00.

FY 1998 Accomplishments:

- 8940 - Expanded environmental technology by installing supercritical carbon dioxide painting, laser paint stripping, expanded Flashjet xenon stripping and sputtering equipment. Demonstrated environmentally acceptable technologies on DoD components, conducted technology transfer activities (requirements determination, technology selection, equipment selection, installation, de-bugging, training) for DoD facilities.
  - Provided Support to DoD/Army ISO 14000 Pilot Program.
  - Developed the Environmental Cost Analysis Methodology (ECAM).
  - Developed the Risk-Based Tiered Approach (RBTA) for environmental risk assessments.
  - Developed an EPA approved Standardized Test Protocol for Organic Coatings.
  - Completed the Congressionally-directed Nitrem process demonstration.

Total 8940

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology / PROJECT: A829

FY 1999 Planned Program:

- 14507 - Compete the Congressionally-directed "Materials and Processes Partnership for Pollution Prevention (MP4)" program. This will include:
  Assessing DoD pollution prevention technology needs.
  Conducting requirements analysis to establish goals and requirements for new technology or management solutions.
  Developing, testing, and demonstrating technology and management solutions including cost and health risk impacts.
  Transitioning new technologies and processes to the Army industrial base and other DoD and commercial sites.
- 394 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 14901

FY 2000 Planned Program: Program to transfer to PE 0708045A.

FY 2001 Planned Program: Program to transfer to PE 0708045A.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A835

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A835 Military Medical Environmental Criteria	3506	3134	2426	2865	2927	3098	3374	3778	Continuing	Continuing

Mission Description and Justification: This project evaluates human health and environmental 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 human health and the environment from adverse effects. The products of this research are US Environmental Protection Agency approved health advisories and criteria documents to be used in risk assessment procedures. These criteria are used by the Army during negotiations with regulatory officials to set scientifically and economically rational safe cleanup and discharge levels at Army installations. The primary developing laboratories are the US Army center for Environmental Health Research (CEHR), Ft. Detrick, MD, the Center for Health Promotion and Preventive Medicine (CHPPM), Edgewood, MD, and the Waterways Experiment Station (WES), Vicksburg, MS.

FY 1998 Accomplishments:

- 1866 - Performed toxicological evaluations and metabolism studies on munitions and degradation products. (CHPPM)
  - Developed toxicity predictions of munitions by-products using structure activity relationships. (CHPPM)
  - Completed cross-species extrapolation of results from immunotoxicity studies in mammalian and non-mammalian bioassays. (CEHR/CHPPM)
  - Applied specific sentinel environmental toxicity hazard assessment methods as part of integrated hazard assessment of sites at Army installations. (CEHR)
  - Performed interlaboratory and field validation of specific sentinel environmental toxicity hazard assessment methods. (CEHR)
- 1640 - Developed exposure and effects models and decision-making framework for ecological risk assessment. (WES)
  - Developed fate and transport of UXO, military-unique compounds, and microbial biomarkers. (WES)
  - Identified biomarkers to monitor bioattenuation and effects of military-unique compounds. (WES)

Total 3506

FY 1999 Planned Program:

- 3051 - Develop munitions biomarkers and bioeffects and conduct toxicological evaluation of munitions and degradation products. (CHPPM)
  - Develop toxicity predictions using structure activity relationships. (CHPPM)
  - Perform cross-species extrapolation of mammalian and non-mammalian bioassays (CEHR/CHPPM), apply sentinel biomonitoring systems (CEHR), and apply methods for integrated environmental assessment of contaminated sites at Army installations (CEHR).
  - Develop fate and transport of military-unique compounds. (WES)
  - Identify biomarkers to monitor bioattenuation and effects of military-unique compounds. (WES)
  - Develop exposure and effects models and decision-making framework for ecological risk assessment. (WES)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A Environmental Quality Technology
	PROJECT A835

FY 1999 Planned Program: (continued)

•	83	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	3134	

FY 2000 Planned Program:

•	1211	- Develop toxicity values for use in a Risk Assessment Modeling System (RAMS). (CHPPM) - Develop biomarkers to assess various toxic endpoints as well as bioaccumulation. (WES/CHPPM) - Perform interlaboratory and field validation of specific sentinel environmental toxicity hazard assessment methods. (CEHR) - Apply specific sentinel environmental toxicity hazard assessment methods as part of integrated hazard assessment of sites at Army installations. (CEHR)
•	1215	- Develop comprehensive exposure model and integrate with RAMS. (WES) - Develop screening level model for UXO. (WES) - Identify parameters for bioaccumulation of explosives in specific endpoints. (WES)
Total	2426	

FY 2001 Planned Program:

•	1431	- Develop comprehensive risk assessment linkages for RAMS. (WES/CHPPM) - Develop effects information to input into comprehensive RAMS. (CHPPM) - Perform interlaboratory and field validation of specific sentinel environmental toxicity hazard assessment methods (CEHR) - Apply specific sentinel environmental toxicity hazard assessment methods as part of integrated hazard assessment of sites at Army installations. (CEHR)
•	1434	- Determine effects of environmental parameters on UXO chemical signatures. (WES) - Develop population model for assessment of environmental effects. (WES) - Develop comprehensive risk assessment linkage for RAMS, linking contaminant fate and transport with effects databases for multiple endpoints. (WES)
Total	2865	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A876

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A876 Plasma Energy Pyrolysis System	5621	2980	0	0	0	0	0	0	0	8601

Mission Description and Justification: Funds for this project were provided by Congress in FY97 through FY99. This project provides a compliance and pollution control technology required reducing the cost of treatment and disposal of hazardous and toxic site waste streams resulting from production or deactivation of military items or components. Plasma arc technology application enables the military to reduce the need for landfills and their future liability-related issues in a one step, safe, and economic process. The project will deliver an effective compliance technology to control and dispose of recalcitrant hazardous and toxic wastes regulated under Resource Conservation and Recovery Act amendments, in addition to satisfying the increasingly stringent emission standards of the Clean Air Act relevant to open burning/open detonation practices within the military. A plasma arc processing unit can reduce the significant costs associated with the many steps involved in other conventional hazardous waste treatment technologies, such as: sample characterization lead time, health and safety exposure risks to workers, and increased risks to the general public from accidents involving the excavated and transported wastes. The development and field demonstration of plasma arc technology will provide the user community with a much-needed tool for military hazardous waste processing and disposal on a flexible basis. In particular, developing a mobile unit's specifications, design, and blueprints will enable the Army, working with the Air Force, to converge on a mobile unit configuration and cut the time for field implementation.

FY 1998 Accomplishments:

- 5621 - Developed plans and obtained permits for mobile system for field demonstration.
  - Designed and procured mobile unit for field applications.
  - Selected demonstration locations and finalized plans.
  - Program will continue in FY99 with the FY98 funds and includes:
    Demonstrating the mobile PEPS capability at three demonstration sites to test the capability to handle hazardous wastes on-site.
    Completing information processing for the preparation of Federal, State, and local permit applications.

Total 5621

FY 1999 Planned Program:

- 2902 - Complete procurement of mobile unit components and system integration.
  - Complete shake-down and mobility testing.
  - Obtain National Environmental Protection Act and other operating permits.
- 78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2980

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A Environmental Quality Technology
	PROJECT A876

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A877

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A877 Western Environmental Technology Office Environmental Support	6558	3974	0	0	0	0	0	0	0	10532

Mission Description and Justification: This Congressionally-directed effort with the Western Environmental Technology Office (WETO) provides for the transfer of environmental compliance technologies required to reduce the cost for treating hazardous and toxic pollutants from Army industrial operations which include Army ammunition plants, depots, and arsenals, and to help satisfy increasingly stringent environmental regulations on DoD and the Department of Energy (DOE). Those environmental requirements include wastewater discharge standards under the Clean Water Act and relevant State regulations, hazardous air pollutant emission standards under the Clean Air Act Amendments (CAAA), requirements under Federal Facilities Compliance Act and Resource Conservation and Recovery Act and other regulations. The U.S. Army Construction Engineering Research Laboratories (CERL) works closely with the Industrial Operations Command (IOC) to transfer environmental compliance and pollution prevention technologies to IOC installations. This project will support the transfer of environmental technologies to IOC installations. This enables the Army to reduce environmental compliance costs and future environmental liability costs. The technology transfer projects under this project should result in model industrial operations with environmental compliance, which will help accelerate technology transfer to similar industrial operations within DoD. The primary technology transfer agency is the U.S. Army Construction Engineering Research Laboratories, Champaign, IL. WETO is a privatized former component of DOE (as of September 1996). WETO will evaluate and demonstrate technologies to help DOE meet a requirement to clean up its sites.

FY 1998 Accomplishments:

- 6558 - Program was initiated late in FY98 and will continue into FY99 with carry-over FY98 funds. Work will include:
  Evaluation of technologies to remove and detoxify metals and energetics in wastewater and to treat oily waste and solvents.
  Fabrication of a pilot-scale, mobile, plasma-arc, military waste destruction system.

Total 6558

FY 1999 Planned Program:

- 3869 - Complete design services and cost-benefit analyses in support of environmental compliance at Army industrial installations.
- 105 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3974

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A Environmental Quality Technology PROJECT A895

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A895 Pollution Prevention Technology	0	609	0	0	0	0	1551	2190	Continuing	Continuing

Mission Description and Justification: The objective of this project is to develop pollution prevention technologies that directly support Army training, maintenance, and industrial support/manufacturing. Investment in pollution prevention technologies enhances Army Warfighting by maintaining readiness as well as ensuring uninterrupted training. The goal of this project is to increase the availability of Army systems and to reduce life cycle costs by 15-30% through the elimination or reduction in the usage of hazardous/toxic substances in the design, manufacture, maintenance, and disposal of Army materiel. This project funds four specific tasks: (1) the continued development of new primer compositions for small caliber ammunition known as Metastable Interstitial Composites (MICs). This task is part of the integrated Green Bullet initiative and is the technology to eliminate lead salt compounds used in today's military small arms primers; (2) the elimination of electrodeposition of hazardous chromium from chromic acid to bore surfaces of medium caliber gun barrels through the use of Cylindrical Magnetron Sputtering technology and the employment of new coating materials. This task is part of the integrated Green Gun Barrel Initiative; (3) the development of a new, non-toxic, low volatile organic compounds (VOC), wash primer for use as a metal surface pretreatment for both ferrous and non-ferrous surfaces to eliminate the high cost of installing and operating mandated air quality compliance systems at the application facilities; and (4) the development of novel in-process surface/solvent diagnostics technology for metal cleaning operations to minimize solvent usage where use of organic solvents cannot currently be eliminated. Having automated diagnostics for both the metal surface cleanliness and the solvent contaminant level will assure the minimization of hazardous waste generation for metal plating and coating processes. The project addresses high priority Army environmental quality technology user requirements and supports compliance with pollution reduction goals set forth in Presidential Executive Order 12856. This project is managed for the Army Materiel Command by the Industrial Ecology Center located at the U.S. Army Armaments Research, Development, and Engineering Center, Picatinny Arsenal, NJ.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

•	593	- Establish critical manufacturing/processing baseline; test and evaluate control parameters for MIC synthesis. - Complete fabrication of test apparatus and apply new coatings to test specimens using a cylindrical magnetron sputtering (CMS) approach. - Identify and evaluate candidate water-based and high solid polymer wash primers for adhesion, salt spray resistance, and appearance. - Complete measurement of spectra versus concentration for representative contaminants and develop algorithms for quantification from observed spectral features.
•	16	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	609	

FY 2000 Planned Program: Project not funded in FY 2000.

	DATE **February 1999**
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602720A Environmental Quality Technology**

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A896

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A896 Base Facility Environmental Quality	2973	4294	4676	5196	5144	5299	5722	5858	Continuing	Continuing

Mission Description and Justification: This project provides the Army with the technical capability to protect and improve the biological and physical characteristics of fixed installation training and testing areas needed to sustain readiness while also conserving protected natural and cultural resources, including threatened and endangered species. Technology developed within this project will enable training and testing land users to match usage events and schedules to the capabilities of specific land areas, and will also provide advanced methods to restore lands damaged in readiness exercises. Efforts under this project will also enable the Army to prevent pollution in facilities base operations, and to comply with the myriad Federal, state, and host country environmental regulations dealing with hazardous and non-hazardous water, wastewater, air emission, solid waste (including sediment discharge) and noise. An additional effort is the development of environmental monitoring and modeling capabilities to support environmentally sustainable installation lands and facilities. The primary developing agency is the U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

FY 1998 Accomplishments:

- 2973 - Developed cause/effect relationships between training activities and impacts on threatened and endangered species.
  - Completed addition of weather statistics and terrain effects on improved noise propagation models.
  - Identified and characterized the mechanisms that cause volatile organic carbon emissions from solvent and petroleum product usage.
  - Completed geomorphologic/probability-modeling guidance for survey of archeological sites.
  - Evaluated military vehicle emissions on global warming.

Total 2973

FY 1999 Planned Program:

- 4294 - Develop validated risk assessment models to determine the effects of Army activities on habitat disturbance.
  - Provide knowledge, approach, and tools to match training land use and land capacity in selected ecoregions.
  - Develop decision support methodologies for assessment and mitigation of maneuver training impacts on threatened and endangered species.
  - Complete guidance for identifying pollution prevention alternatives for Army applications.

Total 4294

FY 2000 Planned Program:

- 4051 - Develop validated risk assessment models to determine the effects of Army activities on habitat disturbance for threatened and endangered species.
  - Develop process-based erosion/deposition models suitable to installation watershed scales.
  - Validate integration of multiple factors for determining land based carrying capacity.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology
	PROJECT: A896

FY 2000 Planned Program: (continued)

- Develop spatial and temporal guidance for management of revegetation of military lands.
- Develop wastewater/stormwater treatment technologies.
- Develop pollution prevention strategies for air emissions control.
- Conduct research into system upgrade technologies to meet Safe Drinking Water Act (SDWA) regulations.

•	625	- Begin development of Hazardous Air Pollutant (HAP) control technologies for hazardous organic materials.
Total	4676	

FY 2001 Planned Program:

•	4471	- Validate the use of remote instrumentation to evaluate changes in animal activity as a result of installation activities.
		- Model the effects of erosion control and revegetation technologies in support of reducing impacts and improving sustained uses.
		- Develop decision support methodologies for selection of land rehabilitation and maintenance alternatives.
		- Develop compliance and mobilization environmental standards for troop installations.
		- Conduct research into system upgrade technologies to meet SDWA regulations.
•	725	- Continue development of Hazardous Air Pollutant (HAP) control technologies for hazardous organic materials.
Total	5196	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A908

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A908 Commercialization of Technology to Reduce Defense Costs Initiative	4683	5961	0	0	0	0	0	0	0	10644

Mission Description and Justification: Funds for this project were provided by Congress in FY98 and FY99. The objective of this technology commercialization program is to significantly lower Department of Defense procurement costs through integration of the technology commercialization process from the laboratory workbench to end product users. Advanced methodologies will be utilized for identification, optimization, and commercialization of developed at federal defense and non-defense laboratories. An Interagency Agreement has been signed with the Federal Laboratory Consortium (FLC) to assist in implementation of this program. This partnership will support DoD by identifying, developing, testing, evaluating, and transitioning state-of-the-art methods and technologies to improve quality, efficiency, and compliance and promote reduction of defense procurement costs.

FY 1998 Accomplishments:

- 4683 - Technology Demand survey conducted. Examined Militarily Critical Technologies List and Army and DoD Environmental Technology Requirements; compiled industry technology roadmaps and other documents; and participated in national and regional FLC/Technology Transfer meetings.
  - Completed technology transition protocols to identify engineering, performance, and test requirements to validate technologies for field/installation applications.
  - Planning completed for systematic assessments and verification of technologies through multilevel testing and demonstration.
  - Market assessment and matching conducted to initially match technology to problems including dynamic underground stripping, high solids anaerobic digestion, laser technology to aid manufacturing, acoustic Doppler non-destructive testing, chemical sensors, remotely operated vehicles for demining and environmental uses, blast resistant flexible fiber composites, and simulation/visualization technologies. Overarching DoD Integrated Process Team established to assist in identification and matching technologies to problems.
  - Thirteen technologies have been assessed/selected for potential commercialization, two Cooperative R&D Agreements were negotiated, and links to venture capital identified.

Total 4683

FY 1999 Planned Program:

- 5803 - Complete requirement and technology matching to fully populate database of available DoD/Federal Laboratory technologies, points of contacts. Vendor/commercial technologies matrixed against manufacturing, sustainment, and environmental needs.
  - Expand role of DoD Integrated Process Team in technology matching.
  - Prioritize DoD needs and complete qualitative and quantitative scoring for selection of DoD/Federal Laboratory technologies.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology / PROJECT: A908

FY 1999 Planned Program: (continued)

- Develop licensing and marketing plans for selected technologies, demonstrate and validate technologies as needed (with assistance of Laboratory and DoD Centers of Excellence), and assist in developing financial plans and resourcing for vendors/licensee as appropriate.
- Complete this program in FY99 by assisting DoD Labs in the development of cooperative R&D/ Licensing agreements.

•	158	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	5961	

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A917

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A917 Computer Based Land Management	3747	2484	0	0	0	0	0	0	0	6231

Mission Description and Justification: Funds for this project were provided by Congress in FY98 and FY99. These funds improve DoD land managers' ability to characterize and monitor broad-scale changes occurring across training and testing lands by utilizing and exploiting remote sensing geographic information systems and field survey and monitoring technologies. Improvements should be made in data acquisition, data display and visualization, and integration of these data into dynamic landscape models. Accurate, effective, and predictive methodologies and models for land condition assessment are needed that correlate and predict the relationship between military use and the patterns and nature of impacts associated with each type of use under varying climatic and landscape conditions. The program develops, tests, and refines these methodologies and models that industry has not pursued.

FY 1998 Accomplishments:

- 3747 - Developed collaborative work plan, defined tasks through workshops, and developed statements of work for each task.
- - Work will be continued into FY99 using carry-over FY98 funds and will include:
  Testing and evaluation of multi-tiered vegetation mapping tools.
  Designing and testing of protocols for network computing with geospatial data and models.
  Designing, acquisition, and implementation of a stream stage monitoring system and soil moisture predictive system to improve real-time scheduling of training activities.
  Designing and testing of tools for quality analysis and validation of geospatial data.
  Designing and testing of procedures and computer-based tools for analysis of change thresholds on military lands.
  Testing of long-term soil impacts of military vehicles on variable soil texture surfaces.
  Designing and testing of computer-based instructions and self-learning modules for integrated resource management plans.

Total 3747

FY 1999 Planned Program:

- 2418 - Evaluate Wind-Erosion Modeling Options for Integration into the Army's land capability model at sites with extensive wind erosion problems (such as Ft. Bliss, TX and Marine Corps Air Ground Combat Center at 29 Palms).
  - Evaluate and test Computer-based learning modules as elements of the decision support capabilities of the Land Management System (LMS).
  - Evaluate vegetation mapping results and lessons learned from FY98 multi-tiered vegetation mapping efforts at Ft. Hood, TX.
  - Evaluate real-time weather and soil moisture data with training usage plans and training distribution model for near term damage and safety assessments.
  - Support protocol development process (workshops, publications) for the Land Management System (LMS).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology / PROJECT: A917

FY 1999 Planned Program: (continued)

- Complete and apply TES and ecological modeling tools developed in support of Ft. Hood at additional sites (Marine Corps Air Ground Combat Center, Ft. Benning, etc).

•	66	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	2484	

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A946

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A946 Electronic Equipment Demanufacturing	0	5960	0	0	0	0	0	0	0	5960

Mission Description and Justification: The objective of this Congressionally-funded Electronics Equipment Demanufacturing program is to develop and demonstrate technologies and processes for the reuse, recycle, or disposal of manufactured electronic equipment used by the Department of Defense and its suppliers. Shortened electronics equipment product life cycles have led to early obsolescence and the 20-year accumulation of hundreds of millions of tons of scrap or surplus commercial and Government electronic equipment. Some of this equipment is classified. Today, there are few alternatives to sending much of this equipment to landfills. The managed reuse of electronic equipment may reduce future procurement costs and will reduce landfill and disposal costs through the separation of hazardous materials.

FY 1998 Accomplishments: Program not funded in FY 1998**.**

FY 1999 Planned Program:

- 5802 - Complete requirements analysis to identify and evaluate potential technologies.
  - Develop, demonstrate, and implement advanced, environmentally acceptable demanufacturing processes at demanufacturing technology demonstration center.
  - Complete and transition demanufacturing technologies to other DoD agencies and commercial sites.
- 158 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5960

FY 2000 Planned Program: Program not funded in FY 2000**.**

FY 2001 Planned Program: Program not funded in FY 2001**.**

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: A947

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A947 Sustainable Green Manufacturing	0	2980	0	0	0	0	0	0	0	2980

Mission Description and Justification: The objective of this Congressionally-funded project is to help the Army reduce pollution in its key manufacturing processes by introducing clean technologies and techniques onto weapon system and related production lines. This is a Congressionally mandated program managed by the Army and consisting of team members that include the National Defense Center for Environmental Excellence, New Mexico State University, and the New Jersey Institute of Technology. New Mexico State University will leverage experiences with predictive modeling and micro-sensor technologies. This program augments efforts to comply with Executive Orders 12856 Greening the Government through Waste Prevention and 13101 Recycling and Federal Acquisition which mandate use of environmentally preferable products and services in all Federal acquisition programs.

FY 1998 Accomplishments: Program not funded in FY1998**.**

FY 1999 Planned Program:

•	2902	- Complete efforts in corrosion prevention and control, training, and modeling and simulation. Corrosion prevention and control efforts will address reduction of corrosion in new and fielded systems through surface protection, material compatibility, embedded sensors, modeling and simulation, lubricants, surveillance modernization, and packaging. - Complete training development efforts that address the needs of the DoD and industry to raise awareness, interest, and competence in managing environmental technologies and concerns. - Complete development of modeling techniques that simulate and predict life-cycle effects/characteristics for more efficient and effective use of resources.
•	78	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	2980	

FY 2000 Planned Program: Program not funded in FY2000**.**

FY 2001 Planned Program: Program not funded in FY2001**.**

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: AF25

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AF25 Military Environmental Restoration Technology	3123	3323	3472	3596	3696	3810	4077	4274	Continuing	Continuing

Mission Description and Justification: This project provides cost effective technologies required to clean up 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. 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; 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. 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 primary developing agency is the U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

FY 1998 Accomplishments:

- 3123 - Completed advanced groundwater sampler/biosensor system as part of the Site Characterization and Analysis Penetrometer System (SCAPS) and initiate evaluation of electromagnetic induction technologies for unexploded ordnance (UXO) detection.
  - Developed Groundwater Modeling System (GMS) Version 2, housing a remedial module with fate/transport packages for explosives and metals.
  - Developed improved chemical analytical techniques for detecting and quantifying special organic compounds in complex media.
  - Provided technical data package of advanced concepts for in-situ biological treatment of explosives-contaminated media.
  - Developed chemical extraction technologies for heavy metals-contaminated soils and continued development of metal speciation and physical separation treatment in soils and groundwater.
  - Completed an evaluation of electromagnetic induction technologies for potential unexploded ordnance (UXO) detection.

Total 3123

FY 1999 Planned Program:

- 3242 - Develop an enhanced instrumentation package for the SCAPS and continue development of UXO detection technologies and of on-site data visualization and analysis capabilities.
  - Incorporate in-situ bioremediation and electrokinetics design modules into the GMS version 2 model.
  - Develop advanced biological ex-situ (bioreactors) and in-situ treatment of contaminated soils and physical/chemical methods for groundwater.
- 81 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3323

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602720A Environmental Quality Technology
PROJECT: AF25	

FY 2000 Planned Program:

- 3472 Complete multi-sensor UXO data collection and demonstrate 50% reduction of false alarms at well characterized UXO test sites.
  - Develop engineering approach for delivery of amendments for in situ treatment or for hydrological modifications to groundwater systems to affect enhanced biodegradation and complete bench scale parameter optimization for reactive barrier enhancement.
  - Complete vapor-phase biological activity enhancing amendment delivery (proof-of-concept) in soil columns, develop engineering approach for delivery of amendments to the vadose zone, and complete correlation of soil/sediment characteristics with contaminant bioavailability.
  - Demonstrate first generation electro-kinetic treatment technologies for lead and Develop prototype instrumentation for on line detection of metal contaminated soils.

Total 3472

FY 2001 Planned Program:

- 3596
  - Develop predictive models for advanced UXO detection sensors (multi- frequency electromagnetic, GPR, vector magnetic, seismic/acoustic, and microgravimetry) and complete advanced UXO sensor data collection effort at a well documented site.
  - Complete pilot-scale demonstration in-situ biodegradation for TNT and demonstrate in-situ reactive barriers and/or reactive barriers coupled with biodegradation for explosives in groundwater.
  - Complete pilot-scale demonstration of in-situ biodegradation for explosives in soils and sediment.
  - Develop aggressive chemical metal treatment for small arms training ranges demonstrate the recycle of metal contaminated extracts for soils treatment systems.

Total 3596

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602720A Environmental Quality Technology PROJECT AF26

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AF26 Agricultural-Based Bioremediation	3747	3974	0	0	0	0	0	0	0	7721

Mission Description and Justification: Funds for this project were provided by Congress in FY97 through FY99. FY1998 Agriculture-Based Bioremediation work has the U.S. Army Environmental Center (AEC) and the U.S. Army Engineer Waterways Experiment Station (WES) demonstrating technologies to restore contaminated military and civilian sites, especially those located in fragile Pacific island ecosystems. In FY99, WES will continue the effort through added research, development, and demonstrations. AEC provides user input and assistance. Demonstrating bioremediation technologies that are agriculturally-based will enhance the Army's ability to restore contaminated sites with fewer dollars and in a way that is widely accepted by the stakeholder community. Using fewer dollars for restoration purposes will allow those dollars to be directed to the readiness stance of the overall military. Stakeholder acceptance, both regulatory and public, is enhanced by employing "green technology." These green technologies, by being efficient and less costly, meet an ever growing requirement to produce clean sites with fewer dollars. Focusing on fragile Pacific island ecosystems could enable the Army to gain regulatory acceptance by the Environmental Protection Agency's Region IX, a major force behind gaining acceptance throughout the remaining regions.

FY 1998 Accomplishments:

- 3747 - The work continues into FY99 with FY98 funds A portion (~50%) of the program focused on data collection to improve scientific and technical assessments of the projects. A broad agency announcement (BAA) was released soliciting new projects to be funded with the remainder of the FY98 funds. Three projects have been selected and demonstration results will be transferred to Hawaiian government agencies, private sector, and academia. A technology transfer agreement was executed with the University of Hawaii.

Total 3747

FY 1999 Planned Program:

- 3869 - The BAA will be extended to solicit additional and complimentary projects. DoD projects will be completed that emphasize agricultural remediation of petroleum contaminated soils and remediation of contaminated sediments using manufactured soil technology.
- 105 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3974

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602720A Environmental Quality Technology

PROJECT: AF27

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AF27 ARO Chemical/Hazardous Material Disposal	0	1490	0	0	0	0	0	0	0	1490

Mission Description and Justification: This Congressionally-funded project will have the Army Research Office (ARO) research ways to conduct on-site chemical and hazardous materials disposal in an environmentally acceptable manner. ARO will identify projects that have promise for on-site disposal (i.e. restoration/remediation) that can be evaluated or developed with a one-time investment. ARO would fund those research projects over a three year period with these funds.

FY 1998 Accomplishments: Program not funded in FY 1998.

FY 1999 Planned Program:

- 1451 - Develop a Broad Agency Announcement (BAA) asking for project proposals for a "Site Restoration - Chemical and Hazardous Materials Disposal Program" which emphasize collaboration with Army scientists/engineers and technology transfer at the end of each project.
  - Select and complete three of the projects identified under the BAA using these funds by FY01.
- 39 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1490

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602782A Command, Control, Communications Technology

COST (*In Thousands*)		FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	16197	22359	19613	21010	20640	20396	21564	22617	Continuing	Continuing
AH92	Communications Technology	8847	12799	11893	12513	11763	10923	11584	12036	Continuing	Continuing
A779	Command/Control (C2) and Platform Electronics Technology	7350	6779	7720	8497	8877	9473	9980	10581	Continuing	Continuing
J06	Multimedia Tactical Adapter	0	2781	0	0	0	0	0	0	0	2781

A. Mission Description and Budget Item Justification: The communications technology project (AH92) conducts research of those advanced communications technologies required to provide a worldwide communications capability. The objective of the command/control (C2) and platform electronics technology project (A779) is to expand scientific knowledge for demonstration of state-of-the-art technologies, including command/control and electronic systems/subsystems, performance reliability, maintainability, safety, survivability, and man-machine interface for all Army air and ground platforms, including soldier systems and equipment. Investigation of an infrastructure that will allow timely distribution, display and use of C2 data on Army platforms will lead to greater battlefield functional capabilities, survivability and total integration into the digitized battlefield. These technologies will provide field commanders with the capability to communicate to and from virtually any place on earth. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this program element is related to and fully coordinated with efforts in PE 0603006A (Command, Control and Communications Advanced Technology), PE 0602783A (Computer and Software Technology) and PE 0603734A (Military Engineering Advanced Technology).

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	16197	19746	18176	18934
Appropriated Value	16838	22546		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-641	-187		
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1437	+2076

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)				DATE: February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602782A Command, Control, Communications Technology			
Current Budget Submit (FY 2000/2001 PB)	16197	22359	19613	21010

Change Summary Explanation: Funding – FY99 funding (+2800) for Project J06 change due to Congressional increase. FY01 funding (+2076) supports communication range extension efforts.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602782A Command, Control, Communications Technology

PROJECT: AH92

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH92 Communications Technology	8847	12799	11893	12513	11763	10923	11584	12036	Continuing	Continuing

Mission Description and Justification: The applied research efforts in this project focus on developing and leveraging/adapting commercial communications technologies required to meet the information needs of the Force XXI battlefield and beyond. Several of the efforts also provide supporting technology for the digital battlefield communications advanced technology demonstration and the battlefield information transmission strategy. Key technologies being addressed include: the adaptation and implementation of asynchronous transfer mode switching technology in a hostile mobile environment, the adaptation and interface with commercial personal communications technology, development of realistic models for emerging communications systems in dynamic field environments, the development and application of several tactical antenna technologies, the development of photonic controls for phased array antennas, and the development of solutions to address problems associated with implementation of mobile internet protocol spread across different networks. These efforts also directly support the information systems and defense technology objectives outlined in the Defense Technology Area Plan and the advanced battlespace information systems study.

FY 1998 Accomplishments:

- 4350 – Completed detailed technical assessment and documentation of baseline dynamic resource allocation-based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multi-media systems using airborne base stations.
  – Completed detailed technical assessment and documentation of existing multicasting protocols including internet protocol (IP) multicasting, IP over asynchronous transfer mode (ATM) multicasting and ATM multicasting for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers.
  – Evaluated, selected and installed a commercial off the shelf (COTS) network node manager and development environment for intelligent network management components.
  – Tested and evaluated a structurally embedded reconfigurable antenna technology (SERAT) conformal antenna mounted on a ground vehicle.
  – Designed, fabricated and evaluated fixed station multiband very high frequency/ultra-high frequency antennas.
  – Conducted development of super high frequency on the move antenna positioner/tracker. Developed element topology for structure tuned very high frequency antenna.
  – Completed design of airborne switching capability to be integrated into super high frequency surrogate satellite communication payload.
  – Completed design of an airborne ATM switch to be used in conjunction with the Digital Battlefield Communications Radio Access Point (RAP).
- 3338 Prototyped integrated photonic control and RF sub-system for single/multi-panel optically controlled phased array communications antennas.
  – Integrated performance models of emerging multicast and multimedia communications technologies and systems with existing CECOM performance models.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A Command, Control, Communications Technology PROJECT AH92

FY 1998 Accomplishments: (Continued)

•	659	– Developed advanced system concepts for future generation dismounted soldier personal communications through analysis of emerging technologies and DARPA SUO Program. Began development of technology transition strategies to Land Warrior System. – Conducted experimentation and assessment of commercial personal communications systems PCS technology in a tactical environment and investigated military back haul capability.
	500	– Developed techniques for tactical internet command and control protection with focus on providing network access protection tools.
Total	8847	

FY 1999 Planned Program:

•	3557	– Design and document analytic and computer models, selections and detailed specifications of dynamic resource allocation based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multimedia systems using airborne base stations. – Design and document enhanced IP multicasting, IP over ATM multicasting, and ATM multicasting protocols for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers. – Integrate initial intelligent, rule-based modules with COTS network node manager and conduct laboratory prototype testing. – Develop Joint Tactical Radio System (JTRS) compatible prototype OTM antenna, covering 30 to 450 MHz frequency bands. – Conduct a cosite performance test and evaluation of VHF multiplexer. - Conduct system test and concept demo for soldier antenna. - Finalize a technical approach, fabricate and test the mechanical inertial positioner and antenna for the super high frequency (SHF) communications on the move (COTM) Antenna.
•	3440	– Complete development of the integrated photonic control system for single/multi-panel phased arrays, and integrate/demonstrate on a single panel phased array antenna. – Investigate and develop ultra high frequency RF multiplexer and wideband power amplifier technologies to reduce interference from co-located radios, reduce noise induced bit errors, and improve radio range performance. – Test UHF RF multiplexer. – Integrate laboratory measurements of ATM performance into system performance models. Provide corps-level analysis capabilities and provide virtual communications systems models that support man-in-the-loop evaluations.
•	2132	-Implement emerging technologies to demonstrate advanced system concepts for future generation dismounted soldier personal communications. Test and evaluate dismounted soldier personal communications technologies in laboratory test and field experiment environments under representative terrain conditions, and analyze vulnerabilities to hostile communication threats. -Implement advanced wireless mobile networking protocols on commercially available, portable computing hosts and radio platforms to demonstrate peer-to-peer and multi-hop packet relay communications networking capabilities.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A Command, Control, Communications Technology PROJECT AH92

FY 1999 Planned Program: (continued)

- Develop advanced of future generation dismounted soldier personal communications by leveraging DARPA Small Unit Operations Situation Awareness System (SUO SAS) Program. Complete development of technology transition strategies to Land Warrior System.

•	3400	– Develop protection techniques for the tactical internet expanding the effort to address intrusion detection and host level protection.
•	270	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	12799	

FY 2000 Planned Program:

•	4894	- Integrate, assess, demonstrate in testbed and document enhanced dynamic resource allocation based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multimedia systems using airborne base stations. - Integrate, assess, demonstrate in testbed and document enhanced IP multicasting, IP over ATM multicasting and ATM multicasting protocols for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers. - Design advanced intelligent modules that inter-operate with fielded network node managers and conduct field testing. -Further develop the Body Borne antenna concept/technologies. -Develop an EHF OTM SATCOM self-steering positioner/tracker. -Demonstrate capability of JTRS compatible OTM antenna, and begin development of expanded bandwidth OTM antenna (2 GHz). -Demonstrate performance increments possible using structure tuned antenna technology.
•	1791	-Transition virtual simulations and performance transition models to Common Modeling Environment (CME) to facilitate model enhancements for Force XXI systems.
•	5208	-Develop protection techniques for the tactical internet with emphasis on malicious code detection and eradication. -Continue advanced development of future generation dismounted soldier personal communications and acquire advanced development prototypes for engineering analysis and system test and evaluation under DARPA SUO SAS Program. Complete development of technology transition strategies to JTRS ground forces domain (Handheld and Dismounted Warrior configurations). -Test and evaluate advanced wireless mobile networking protocols for dismounted soldier personal communications using laboratory test and field experiment environments. Implement networking protocols in computer modeling and simulation environment for evaluation of system scalability and performance issues. -Analyze and evaluate design and engineering approaches for reducing power, weight and size requirements while improving performance of future generation dismounted soldier personal communications. -Assess, characterize, mature and integrate DARPA Global Mobile (GloMo) Geo routing algorithms and Meta channel technology.
Total	11893	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602782A Command, Control, Communications Technology**
	PROJECT **AH92**

FY 2001 Planned Program:

•	5439	-Conduct and document detailed technical assessment of baseline dynamic addressing algorithms and protocols, and dynamic network constitution and reconstitution algorithms and protocols for tactical survivable dynamic mixed networks (ATM, IP, narrow integrated services digital network (N-ISDN)) environment. -Design a distributed network management architecture, which utilizes intelligent 'super agents" for semi-automated end-to-end network management. -Test and evaluate expanded bandwidth JTRS compatible OTM antenna. -Demonstrate prototype soldier antenna.
•	1975	-Complete transition to CME and demonstrate next-generation simulation aids for initialization, management and data reduction. -Complete development and demonstrate EHF positioner/tracker.
•	5099	-Develop protection techniques for the tactical internet with focus on security management. -Test and evaluate DARPA SUO SAS advanced development prototypes in laboratory test and computer modeling and simulation environments. Demonstrate future generation dismounted soldier communications advanced system concepts in field experiment. -Evaluate engineering approaches for implementing second and third generation PCS air interface standards in DARPA SUO SAS advanced development prototypes. -Continue engineering analysis of future generation dismounted soldier communications and mobile computing system advanced development prototypes to reduce power, weight and size requirements while improving performance of dismounted soldier personal communications. -Finalize integration of DARPA GloMo Geo routing algorithms into a 6.3 ATD program.
Total	12513	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602782A Command, Control, Communications Technology

PROJECT: A779

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A779 Command/Control (C2) and Platform Electronics Technology	7350	6779	7720	8497	8877	9473	9980	10581	Continuing	Continuing

Mission Description and Justification: The objective of this project is the exploration of new concepts and techniques in command/control and platform electronics integration to achieve new and enhanced military functional capabilities. Emphasis is on mission planning, rehearsal, execution and monitoring, precision navigation and landing, command and control, and integration with the evolving digital battlefield. New enabling technologies which support the current thrusts are also explored, such as advanced controls and displays, voice interactive technology, 3D visualization, decision aids and tactical planning aids, data transfer, distributed data bases, advanced open system architectures, visionics technology and integration concepts which contribute to digitization of the battlefield and provide command and control on the move. The project serves as a direct technology feed to advanced warfighting experiments (AWEs), advanced technology demonstrations (ATDs), advanced concept technology demonstrations (ACTDs) and defense technology objectives (DTOs), including the following: Battlespace Command and Control (BC2) ATD, Logistics Command and Control (Log C2) ATD, Rapid Terrain Visualization ACTD, Battlefield Awareness and Data Dissemination ACTD, Joint Countermine ACTD, Navigation Warfare ACTD, Consistent Battlespace Understanding DTO; Forecasting, Planning, and Resource Allocation DTO; and Integrated Force Management DTO.

FY 1998 Accomplishments:

- 3475 – Demonstrated real-time platform positioning accurate to 1-3 meters to enhance situation awareness in all environments (electronic counter measures (ECM) and nap of earth) with registration to digital terrain modeling.
  – Conducted flight test of the multi-sensor differential global positioning system (GPS) precision approach/landing. Assembled a precision approach database with raw sensor data that will support the development of new techniques, algorithms and Kalman filters for multiple Army airborne platforms.
  – Evaluated concepts for employing GPS pseudolites (ground based devices transmitting GPS-like signals) to reduce GPS signal acquisition times under a hostile ECM environment.
- 3375 – Demonstrated a battlespace planning and visualization system that integrates emerging technologies with existing DoD systems to enhance battlespace awareness and facilitate tactical assessment, forecasting, information visualization, course of action analysis and other critical C2 functions. Ported planning functionality from high-end workstation environment to personal computer environment. Started development of a collaboration infrastructure to support real-time planning across dissimilar platforms.
- 250 – Enhanced performance models to reflect the evolving tactical internet in support of near-term security architecture analysis and modeling and simulation/stimulation (MSS) specification requirements.
- 250 – Developed a situation awareness model based on field data captured during the Task Force XXI AWE.

Total 7350

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A Command, Control, Communications Technology PROJECT A779

FY 1999 Planned Program:

•	1188	– Develop models and simulate battlespace tactical navigation (BTN) system architecture concepts that provide robust and precise platform positioning. GPS pseudolites, anti-jam GPS, video/imagery registration and small, low cost self-contained sensor technologies will be researched and evaluated. The system concept will be scalable in that it will support multiple platform types at all echelons. – Develop prototype designs for the evaluation of BTN concepts.
•	4235	– Develop and demonstrate battle planning and visualization technology that integrates multiple existing DoD systems with emerging planning and user interface technologies to enhance all-echelon battlespace awareness down to the individual soldier. This battle planning and visualization technology will provide real-time/ near real-time hyperlinks to multiple battlefield information sources and innovatively display and interact with commanders and staff to accelerate and improve the commander's nine-step planning process. Complete and transition the collaboration infrastructure to the BC2 ATD. – Test and evaluate forecasting, continuous planning/scheduling, interactive 3-D exploration of the battlespace, speech/natural language interaction and other advanced capabilities in battlelab/field experiments.
•	750	– Specify and develop a MSS environment to support man-in-the-loop evaluation and warfighter training for advanced command and control protect and attack (C2 P/A) capabilities. Evaluate the effects of C2 attack on tactical internet operations.
•	500	– Develop an information model that describes Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) processes and man-machine interactions for division-level simulations.
•	106	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	6779	

FY 2000 Planned Program:

•	1075	– Evaluate GPS enhancement technologies (e.g., advanced filters, low power clocks, advanced antennas) and prepare a plan for the demonstration of these technologies in air and ground platforms. Conclude simulation of navigation system/database registration error minimization.
•	4983	– Investigate and develop data visualization, forecasting optimization routines and automatic alerts for insertion into the Logistics command and control (C2) advanced technology demonstration (ATD).
•	698	– Integrate a C2 attack simulator with core distributed interactive simulation (DIS) facilities (CDFs). Conduct a distributed simulation using live troops and multiple sites to support development and training for integrated C2 P/A capabilities.
•	499	– Enhance the C4ISR processes model to include corps-level requirements and joint/allied interfaces.
•	465	– Develop an experimentation plan and testbed environment to evaluate future C2 needs of tactical commanders from battalion through platoon.
Total	7720	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A Command, Control, Communications Technology PROJECT A779

FY 2001 Planned Program:

•	2050	– Develop and demonstrate a real-time prototype of the navigation sensor/database error registration minimization algorithm.
•	1294	– Evaluate improved C2 P/A capabilities against each other in a virtual environment to support development and training for C2 P/A capabilities. Integrate brigade and above communications models (e.g., that for mobile subscriber equipment (MSE)).
•	500	– Develop High Level Architecture/Army Battle Command System interfaces as part of a common modeling environment (CME) supporting live/virtual/constructive simulations for all modeling and simulation (M&S) domains.
•	1800	– Conduct laboratory and field experiments with candidate collaborative planning, tactical display, and man-machine interface concepts, built within a portable testbed. Concepts will show proof-of-principle improvement in battlespace situation awareness and decision-making processes for commanders from battalion to squad levels. Concepts will be evaluated toward feasible solutions for smaller, lighter, energy efficient, and software reprogrammable applications.
•	2853	– Develop technology concepts and enablers for next generation command posts and tactical operations centers and the logistics C2 ATD: integrated voice/natural language/collaboration capability to provide C2 on-the-move, course of action tools to support logistics planning and reconstitution, and tools to aid course of action development and analysis in a hasty environment.
Total	8497	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602782A Command, Control, Communications Technology

PROJECT: J06

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
J06 Multimedia Tactical Adapter	0	2781	0	0	0	0	0	0	0	2781

Mission Description and Justification: The objective of this one year Congressional special interest project is to investigate methods that provide a seamless interface from standards/commercial based communications products to the Warfighters Information Network (WIN). The Multimedia Tactical Adapter program will develop an operational prototype to address the interoperability of voice, data and video over a single military communications infrastructure. It will provide the soldier with state of the art technology while adapting commercial technology for use in the tactical environment. The Multimedia Tactical Adapter program will develop a means to provide the required technology to implement a more reliable, efficient, and cost effective multimedia communications system. A Multimedia Inter-Working Functions (IWF) will be developed to provide gateway and gatekeeper functions for various standards based (H.320 and H323) interoperability technologies. Methods to control available bandwidth usage for these technologies will be investigated as well as defining and implementing a scheme to allow for preemption and prioritization of the users multimedia communications. This effort will give the warfighter an enhanced capability that will save setup time, prioritize usage, and conserve precious tactical bandwidth based upon network traffic.

FY 1998 Accomplishments: Program not funded in FY 1998

FY 1999 Planned Program:

- 800 -Complete investigation of approaches to integrate and control various standards based video teleconferencing techniques into tactical communications networks.
- 1908 -Complete design and development of the appropriate hardware and software required prototypes to interface and control Multimedia Communications on tactical Networks.
  -Perform test and evaluation of the completed system.
- 73 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2781

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602783A Computer and Software Technology / PROJECT: DY10

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DY10 Computer and Information Science Technology	658	2170	5210	4012	4170	2291	2491	2610	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element develops and applies information and communication technology to improve the performance and reduce the cost of Army tactical Command and Control (C2) systems and tactical embedded real-time systems. Efforts capitalize on computationally intensive approaches that exploit the rapidly evolving capabilities of emerging commercial computer technology. Focus is on providing general solutions that can be applied to a wide variety of C2 problems. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan, (ASTMP), the Army Modernization Plan and Project Reliance. This program is managed by the Army Research Laboratory (ARL). Research is concentrated in technologies that support command in a distributed environment and analysis tools that support the command process.

FY 1998 Accomplishments:

- 658 - Completed work on Virtual Hardware Development Language (VHDL) models developed in various communication modeling applications (ISDN Layers 1, 2 , 3 and Tactical/Strategic Gateway according to MIL-STD-188-05). Seminal work led to complementary work in the Fed Lab (06011104.H50) and these products were transitioned to CECOM RDEC-SED (Software Engineering Directorate).
  - Completed research for CAPS (Computer Aided Prototyping System). CAPS is an integrated software development environment aimed at rapidly prototyping real-time embedded software systems. CAPS was installed at the TACOM and MICOM RDECs.
  - Participated and conducted research in NARA (National Archives and Records Administration) working group addressing creation, maintenance, and disposition of electronics records.

Total 658

FY 1999 Planned Program:

- 2121 - Develop initial distributed and collaborative group support environment that enables geographically separated commanders to collaborate in real-time and conduct battle planning, rehearsal and management tasks.
  - Demonstrate initial collaborative tool set capability.
  - Develop metrics to assess effectiveness of collaboration tools and environment.
  - Develop network monitoring capability with commercial tools (e.g. OPNET) and build evaluation capability for tactical internet protocol.
  - Investigate interfaces between information management and network management systems to support intelligent tuning of information distribution process.
- 49 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2170

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602783A Computer and Software Technology
	PROJECT: DY10

FY 2000 Planned Program:

- 3810 - Conduct experiments on the initial distributed and collaborative group support environment in concert with Army Battle Labs.
  - Modify tool set capabilities based on experimental results.
  - Incorporate touchless interface tools to facilitate operations on the move (developed in Displays Fed Lab Program).
  - Incorporate course of action development and analysis tools (developed in Displays Fed Laboratory Program).
  - Incorporate low bandwidth Video TeleConferencing (VTC) technology (developed in Displays Fed Lab) to bring capability down to dismounted commander.
  - Develop techniques that will allow the army user to access internet protocol network management information on tactical wireless networks to determine the availability of bandwidth at any given time. Based on this data, develop active database triggering mechanisms that prioritize data packages to be sent.
  - Provide alternative approaches to Tactical Internet / Intranet routing protocol layer.
  - Transition and integrate technologies into CECOM's Cyber Command Post Program (CPP).
- 1400 - Develop and demonstrate secure, internet-based mobile networking protocols to enable the ad hoc, peer-to-peer networking capability required for command on the move.
  - Demonstrate advanced anti-jam algorithms for mobile multiple access networks including adaptive rate source channel coding, interference avoidance techniques, and co-site mitigation.
  - Demonstrate agent-based vulnerability assessment techniques on wireless networks that automatically identify configuration errors.

Total 5210

FY 2001 Planned Program:

- 2632 - Conduct Battle Lab experiments with second generation collaborative technologies and identify technology gaps.
  - Integrate intelligent agent technologies (research conducted in 0601102.H48).
  - Utilize planning metrics for display design (developed in Display Fed Lab) to enhance assimilation of information by commanders.
  - Measure and evaluate performance improvement of information management algorithms responding to network delay feedback.
  - Conduct experiment to empirically measure overhead due to intranet routing protocols and compare to simulation results.
  - Provide upgraded technology modules to CECOM's Cyber CPP.
- 1380 - Develop and demonstrate advanced multicast mobile ad hoc networking protocols with interoperability with the fixed Internet, airborne routers, and satellite communications.
  - Demonstrate agent-based vulnerability assessment techniques on highly mobile networks that automatically identifies configuration and implementation errors.
  - Demonstrate advanced compression techniques for multimedia delivery over tactical networks including reliable layered Quality of Service (QOS)-capable video and information-hiding mechanisms for authentication.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602783A Computer and Software Technology — PROJECT: DY10

Total 4012

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	658	2185	3324	2217
Appropriated Value	679	2185		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-21	-15		
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1886	+1795
Current Budget Submit (FY 2000 / 2001 PB)	658	2170	5210	4012

Change Summary Explanation: Funding – FY 2000 (+1948) and 2001 (+1854) - Funds added to enhance AAN-focused Science and Technology Objective (STO), Collaborative Technology for the Warfighter and to enable transition of products from the Advanced Telecommunications Federated Laboratory.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	55978	52074	41085	42820	45270	46584	49153	52188	Continuing	Continuing
A855 Topography, Image Intelligence, and Space Technology	8653	9022	9494	9722	10315	10788	11494	12162	Continuing	Continuing
AH71 Atmospherice Investigations	5574	5657	6270	6652	7068	7328	7928	8367	Continuing	Continuing
AT40 Mobility & Weapons Effects Technology	11602	12617	14896	15692	16586	16577	17126	18247	Continuing	Continuing
AT41 Military Facilities Engineering Technology	3371	3982	4165	4204	4505	4725	5042	5375	Continuing	Continuing
AT42 Cold Regions Engineering Technology	4423	4516	3677	3754	3945	4142	4311	4573	Continuing	Continuing
AT45 Energy Technology Applied to Military Facilities	2243	2386	2583	2796	2851	3024	3252	3464	Continuing	Continuing
AT46 Climate Change Fuel Cell Technology	7026	2967	0	0	0	0	0	0	0	9993
AT47 Molten Carbonate Fuel Cell Technology	6000	0	0	0	0	0	0	0	0	6000
AT48 Center for Geosciences and Atmospheric Research	7086	0	0	0	0	0	0	0	0	7086
AT49 University Partnering for Operational Support	0	2980	0	0	0	0	0	0	0	2980
AT50 Enhanced Geographic Synthetic Aperture	0	7947	0	0	0	0	0	0	0	7947

A. Mission Description and Budget Item Justification: The applied research conducted in this program provides technology in direct support of critical warfighter functions of mobility, countermobility, survivability, sustainment engineering, and topography needed to win on the modern battlefield. Research is conducted that supports the special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Key operational technologies developed are demonstrated to Army units under program element 0603734A (Military Engineering Advanced Technology). Results are tailored to support the material development, test, and acquisition community in evaluating the impacts of weather, terrain, and atmospheric obscurants on military operations. Research develops and exploits a wide range of innovative technologies and applies them to Defense unique planning, acquisition, revitalization, and sustainment processes. The goal of this research is to 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 work in this program is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Defense Reliance Agreements on Civil Engineering and Battlespace Environments with oversight provided by the Joint Directors of Laboratories and Joint Engineers.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	50802	37488	39998	40364
Appropriated Value	58422	52688		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1620	-614		
b. SBIR / STTR	-406			
c. Omnibus or Other Above Threshold Reductions	-134			
d. Below Threshold Reprogramming	-284			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1087	+2456
Current Budget Submit (FY 2000 / 2001 PB)	55978	52074	41085	42820

Change Summary Explanation: Funding – FY 1999 – Several Congressional adds, totaling to a plus-up of 15200.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: A855

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
A855 Topography, Image Intelligence, and Space Technology	8653	9022	9494	9722	10315	10788	11494	12162	Continuing	Continuing

Mission Description and Justification: This project funds technology to enhance the tactical commander's ability to effectively visualize the battlespace, to easily represent battlefield information, and to exploit his knowledge of combat relevant intelligence as a force multiplier to conduct and win Force XXI operations across the operational continuum. Information dominance is a key enabler for Army/Joint Vision 2010 concepts. Using tactical/strategic/space sensor data, together with terrain data bases as input, the technology program emphasizes automating the processes of detecting changes on the battlefield, identifying battle significant features, exploiting space based/remote sensing information (especially for deep operations and over denied areas), and integrating the impacts of the battlefield environment to significantly improve combat planning and operations. Development efforts will enable the commander to locate and position enemy and friendly forces in day/night all-weather conditions, provide crucial terrain data for command and control systems (C2) as well as modeling and simulation systems, and enhance the speed and accuracy of maneuver and weapon systems. The technology being developed will help those who move, shoot, and communicate on the battlefield to "fight smarter" through superior knowledge of the total battlefield terrain and environment. Work in this project significantly enhances the geospatial data management and dissemination capabilities of storing, formatting, transforming, and distributing extremely large volumes of terrain data at real or near-real times. Weather/atmospheric effects data is provided by the Army Research Laboratory Project AH71 in this PE. This project is managed by the U.S. Army Topographic Engineering Center, Alexandria, VA.

FY 1998 Accomplishments:

- 8653 - Developed initial capability for automated feature attribution based on multispectral imagery data.
  - Linked 3-D model and texture library to database generation capability.
  - Developed parametric modeling capability for battlefield terrain simulation.
  - Developed procedures for ensuring that mapping, charting, and geodesy (MC&G) software adheres to the Defense Information Infrastructure.
  - Developed new methods for portraying terrain analysis product reliability.

Total 8653

FY 1999 Planned Program:

- 8919 - Incorporate/test initial spectral imagery and synthetic aperture radar automated feature extraction capabilities.
  - Develop standards, initiate linear feature management development, and demonstrate the management, dissemination, and integration of point data and information.
  - Develop capabilities to support weapon selection by applying physics-based models to simulate applications and visualization capabilities.
  - Develop and explore processes to utilize a disparate array of geospatial information to support a family of common geospatial information representations.
  - Test and evaluate a vehicular advanced tactical navigator capability and initiate design of an off-vehicle advanced tactical navigator capability.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
	PROJECT A855

FY 1999 Planned Program: (continued)

•	103	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	9022	

FY 2000 Planned Program:

•	9494	-Incorporate automated feature extraction techniques from spectral, synthetic aperture radar and electro-optical sources into the digital stereo photogrammetric workstation. - Develop a capability to manage, disseminate, and integrate topographic point and line feature data. - Extend physics-based models and visualization capability to passive and active millimeter wave. - Complete design and tests of off-vehicle advanced tactical navigator.
Total	9494	

FY 2001 Planned Program:

•	9722	- Develop capability for automated feature attribution based on terrain reasoning. - Test and evaluate the ability to manage, disseminate and integrate point, line and aerial information under operational conditions. - Integrate model derived from infrared and multimeter wave sensor performance overlays into 3D visualization. - Develop the design for hardware and software for future land navigation capability.
Total	9722	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AH71

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AH71 Atmospherice Investigations	5574	5657	6270	6652	7068	7328	7928	8367	Continuing	Continuing

Mission Description and Justification: This project realistically models atmospheric effects on target acquisition, mobility, lethality, and survivability to provide weather limitations for design and operation of smart weapons, improved war game realism and tactics and improved intelligence preparation of the battlefield. It develops weather decision aids for the commander by: applying advanced computer techniques; incorporating new technology in meteorological sensor design; and developing data fusion techniques to horizontally integrate data from advanced weather sensors and non-weather sensors into decision aids to enhance combat power on the battlefield. This project supports Project Reliance theater data fusion and prediction, atmospheric effects assessment, and battlefield environmental effects joint programs.

FY 1998 Accomplishments:

- 3483 - Increased forecast accuracy of the Battlescale Forecast Model (BFM) by initializing with higher resolution Air Force and Navy model data and integrating into the Integrated Meteorological System (IMETS) for the Army Battle Command System (ABCS).
  - Developed the capability for the All Source Analysis System, the Digital Topographic Support System, the Advanced Mobile Profiling System, and the Maneuver Control System to concurrently retrieve and incorporate weather information in Intelligence Preparation of the Battlefield, trafficability, aviation, and nuclear/biological/chemical applications.
  - Converted the Electro-Optical Tactical Decision Aids including weapon zones, target acquisition ranges, and thermal reversal for integration with current tactical Weather Effects Decision Aids (WIDA).
- 2091 - Demonstrated through the use of achieved data the accuracy achieved by moving the battlescale forecast model (BFM) to indirect fire control computers to correct for met effects over the entire trajectory for improved accuracy of artillery fires.
  - Completed the integration of the prototype MMS-Profiler computers and sensors with data retrieval, database, and BFM software on a suite of Army or equivalent computers.
  - Examined and devised computationally efficient algorithms for dynamic weather data transformations for parallel and scaleable processing architectures with the dynamic terrain data transformations developed in this PE under Project A855.

Total 5574

FY 1999 Planned Program:

- 3133 - Evaluate converting the BFM to a nonhydrostatic model to improve predictions of severe weather.
  - Enhance forecaster decision aids with improved algorithms for predicting icing, turbulence, visibility, low cloud, and precipitation.
  - Incorporate existing acoustic detection algorithms into tactical decision aids using the BFM output to enable troops to determine the optimum placement of acoustic sensors for detection based on atmospheric conditions.
  - Incorporate an improved BFM for forecast representations in combat simulation and training, including clouds, fog, severe weather, and improved battlefield aerosol diffusion at tactical scales.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
	PROJECT AH71

FY 1999 Planned Program: (continued)

•	1470	- Evaluate the Prototype MMS-Profiler's ability, at 4th Infantry Division Digitized rotation to provide target area trajectory meteorology for close and deep attack systems; begin insertion of software upgrades such as improved satellite sounding retrievals and BFM.
•	1017	- Develop a user interface for 2-dimensional limited complex terrain/acoustic propagation model for integration into next generation IMETS and C2 systems. - Use transient turbulence theory to develop a high resolution, complex terrain transport and diffusion model which will permit simultaneous calculation of meteorology and hazards prediction with significantly reduced computation time by eliminating the stepwise procedure of traditional approaches for deployment in next generation IMETS and C2 systems. - Investigate visualization techniques for fusing multiple information sources into a unified visualization of weather with the rapid, dynamic, 3-D battlefield environment/terrain visualization capabilities.
•	37	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	5657	

FY 2000 Planned Program:

•	2421	- Complete the initial neural network method for retrieval of wind profiles from met satellite sounder data. - Deliver meteorological algorithm with documentation to the Army's Armament Research, Development, and Engineering Center (ARDEC) for enhanced fire support effectiveness. - Conduct verification and validation of battlescale forecast model with improved algorithms for predicting icing, low level clouds, turbulence, precipitation, and visibility for input to battlefield decision aids.
•	525	- Incorporate limited terrain effects into the Battlefield Acoustic Sensor Evaluation (BASE). - Develop a user interface for acoustic propagation in 2-D limited complex terrain for integration into next generation IMETS and command and control systems.
•	3324	- Incorporate Joint Technical Architecture Standards into IMETS applications to establish a consistent representation of weather and weather impact information on ABCS C2 systems. - Prepare, evaluate, test, and integrate meteorological forecast models, meteorological data bases, and weather impact decision aids into the Army's first digital division. - Integrate IMETS applications including weather data visualization, rule-based and physics-based weather impact models as client applications onto the ABCS C2 systems to provide an interactive capability and ability for ABCS to retrieve data on demand from IMETS meteorological data bases. - Incorporate meteorological satellite data extraction algorithms for surface state and precipitation into weather information data bases, visual displays, and decision aids. - Upgrade weather impact decision aid models with the characteristics and impacts of weather on threat platforms, weapons, sensors, and operations.
Total	6270	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
	PROJECT AH71

FY 2001 Planned Program:

•	2544	- Conduct verification and validation of neural network method for retrieval of wind profiles from met satellite sounder data. - Integrate combined temperature retrieval method into MMS-Profiler processors for better temperature sounding capability. - Upgrade phased array wind radar antenna to include electronic beam steering that will replace electro-mechanical switches to provide a potential sounding-on-the-move capability for enhanced mobility. - Conduct verification and validation of battlescale forecast model modules for icing, low level clouds, and precipitation. - Deliver to ARDEC a new method of aiming artillery by applying met corrections along the entire trajectory for better accuracy and enhanced fire support effectiveness.
•	956	- Incorporate full terrain/turbulent scattering acoustic propagation model into next generation weather decision aid systems. - Incorporate complex terrain acoustic propagation decision aid. - Integrate joint weather impacts into decision aids for the first digital division weather capability.
•	3152	- Port the IMETS meteorological forecast and weather impact decision aid applications to laptop and desktop computer systems for battlefield portability. - Develop a weather data server for distributing IMETS gridded meteorological data and weather impacts data base information to ABCS clients at lower echelons where there is no full IMETS capability. - Install IMETS applications and upgrades on all ABCS C2 systems. - Implement a capability for IMETS to participate with both live and synthetic weather scenarios in live, virtual, and constructive simulation exercises leading to the first digital Army Corps.
Total	6652	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT40

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT40 Mobility & Weapons Effects Technology	11602	12617	14896	15692	16586	16577	17126	18247	Continuing	Continuing

Mission Description and Justification:. This project will provide warfighters the technologies for: rapid establishment and repair of lines of communications by both light and heavy engineers in support of U.S. force deployment; designs, materials, and construction methods for battlefield, fixed, and forward base survivability against advanced conventional weapons and terrorist weapons; methodologies to predict and mitigate coastal effects on logistics -over-the-shore (LOTS) operations; reliable and cost-efficient roadways and airfields for CONUS installations to support force projection; camouflage, concealment, and deception for fixed and semi-fixed facilities to deny accurate acquisition and engagement by threat weapon systems; rapid obstacle and barrier creation; and accurate assessments of battlefield mobility for maneuver commanders (and materiel developers during virtual prototyping). Civil engineering science and technology in this project directly supports the Army's DoD Project Reliance S&T responsibilities in airfields and pavements, survivability and protective structures, and sustainment engineering. The work is managed by the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

FY 1998 Accomplishments:

- 11602 - Developed simplified survivability analysis procedure for field fortifications; developed camouflage materials and light-weight material revetments for protection of aviation assets; developed/evaluated materials for large area, thermal signature tonedown.
  - Conducted 3-D lab-scale experiments of rapidly installed breakwater concepts for logistics-over-the-shore operations; developed initial methodology for rapid generation of river basin models for hydrologic forecasting; modeled effects of grid size and time step to determine operational limits.
  - Developed advanced pavements material characterization and classification procedures; developed new materials and methods for expedient airfield construction; evaluated epoxy/polymer materials for expedient strengthening of roadway surfaces.
  - Validated algorithms to infer structural attributes that are not available but required for bridge assessments; developed techniques for rapid soils properties determination; evaluated techniques for rapid repair of damaged bridges; developed model to predict roadway deterioration under military unique loads in emerging countries; evaluated techniques for assessing the throughput capacity of the transportation network.
  - Enhanced NATO Reference Mobility Model for replication of dynamic deformable soil-tire/track interactions; determined impact of mission specific digital terrain data on mobility predictions.

Total 11602

FY 1999 Planned Program:

- 12617 - Develop techniques for troop evaluations of the structural integrity of small protective emplacements; evaluate concepts for application of sprayable multispectral camouflage, cover, and deception (CCD) tonedown agents for large area signature reduction; correlate target structural damage with target type, geometry, and materials and demolition method.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
PROJECT AT40	

FY 1999 Planned Program: (continued)

- Develop analytic methodologies to predict down-axis ground shock from fully coupled detonations in slabs; complete static and dynamic laboratory experiments and associated analyses of square concrete structural components with large span-to-thickness ratios; develop and validate hardening techniques for roofs to resist vehicle bomb threats.
- Design specifications for rapidly installed breakwater; incorporate algorithms into Riverine Analysis Model to calculate probability bands for hydrologic predictions; incorporate real-time nowcast data analyses into logistics-over-the-shore planning model.
- Establish criteria and procedures for the use of local materials and equipment for construction of expedient airfields; validate analytic models capable of replicating dynamic pavements and materials response under vehicle loading and multiple tire interactions.
- Develop an analytic capability for automated assessment and load classification of bridges; establish procedures for use of soil vitrification for soil stabilization; complete initial software for synergistic allocation of engineer assets within resource constraints to transportation infrastructure maintenance, repair, and construction tasks.
- Develop soil constitutive relationships describing the traction performance of tires operating in coarse-grained soils; develop stress distribution model for tire/track/soil contact area; conduct in-situ field experiments to measure normal and tangential forces occurring at the vehicle/soil interface.

Total 12617

FY 2000 Planned Program:

- 13896 - Develop infrared signature manipulation techniques for use in expedient decoy construction; perform survivability analysis of protective concepts for key assets in forward logistic nodes.
  - Develop analytic methodologies to predict down axis ground shock from detonation partially above and in burster slab; develop and validate methods for hardening walls to resist terrorist mortar threats.
  - Complete final version of Coastal Integrated Throughput Model; incorporate snow melt capabilities into military hydrologic model.
  - Develop methodology for making short-term forecasts of soil strength based on predicted weather changes.
  - Integrate Improved Bridge Assessment Rehabilitation and Repair (IBARR) code with road assessment algorithms; establish criteria for off-road/bypass evaluation around damaged road networks.
  - Incorporate multiple-wheel interaction and dynamic response analysis into an advanced pavement analysis model.
- 1000 - Develop techniques to predict the effects of asymmetric terrorist threats against dams and dam support structures.

Total 14896

FY 2001 Planned Program:

- 14692 - Upgrade survivability analysis algorithms for blast and fragmentation effects to include CCD measures; troop evaluation of protective concepts for base clusters and forward logistic nodes.
  - Develop analytic methodologies to predict down-axis ground shock from detonation partially in and below burster slab; complete dynamic experiments and analyses of square concrete structural components with intermediate span to thickness ratios; develop methods for hardening roofs to resist terrorist mortar threats.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
	PROJECT AT40

FY 2001 Planned Program: (continued)

- Incorporate Coastal Integrated Throughput Model into military hydrologic models and a tactical logistics planning exercise to validate improved, robust basin delineation computer sub-routines.
- Develop operational unit level movement algorithms for representation of maneuver in Army models and simulations.
- Determine techniques for use of indigenous materials in maintenance, repair, and construction of roadways; develop procedures/guidance for engineer resourcing in repair/maintenance of roadways; develop bridge repair/retrofit materials and components; develop methodologies for assessment of impact on roadway components of vehicle speeds, tire pressures, loadings, etc.
- Incorporate reliability concepts into the pavement performance model, incorporate long-term behavior analysis into the advanced pavement analysis model.

•	1000	- Develop prediction techniques for effects of asymmetric terrorists' threats against locks, levees, and flood control structures.
Total	15692	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT41

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT41 Military Facilities Engineering Technology	3371	3982	4165	4204	4505	4725	5042	5375	Continuing	Continuing

Mission Description and Justification: This project exploits innovative developments in a wide range of technologies to achieve critically needed cost reductions in Army facility life cycle processes (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal). Current Army infrastructure operations, maintenance, and repair cost alone is about $8.5 billion per year. The goal for the DoD Technology Area Plan is to reduce facility acquisition and maintenance and repair costs 15% by FY 2001 from a 1985 baseline. Meeting this critical goal is not possible without application of significant technology innovation. Products already developed and projected for the future have high civilian sector dual use potential. These include innovations in composite materials, concurrent engineering, collaborative decision support, corrosion resistant coatings, seismic vulnerability evaluations, and knowledge processing. Additionally, significant soldier retention benefits also accrue from providing professional work environments and high quality communities for military families. Under the DoD Project Reliance initiative, the Army is responsible for managing the conventional facilities research and development needs of all the military services through the Construction Engineering Research Laboratories, Champaign, Illinois.

FY 1998 Accomplishments:

- 3371 - Demonstrated the Open Collaborative Engineering framework for modular design and integrated military facility management.
  - Initiated development of ferromagnetic active tags to monitor status of military structural building systems.
  - Developed seismic evaluations and rehabilitation methods for military steel frame buildings.

Total 3371

FY 1999 Planned Program:

- 3982 - Enhance the Modular Design for Systems to accommodate 80% of Army facility types.
  - Initiate development of self-repairing facings, coatings, and membranes for military buildings containing distributed reactive materials in inert casings which when released enable self-repair.
  - Develop criteria for upgrading seismically vulnerable, concrete frame, barracks structures.

Total 3982

FY 2000 Planned Program:

- 4165 - Develop advanced structural integrity monitoring systems that provide information for assessing structural health, safety and remaining service life.
  - Develop design criteria for non-specific Electro-osmotic Pulse (EOP) system to prevent structural damage from chronic water seepage through floors, walls, and roofs.
  - Develop remote corrosion monitoring techniques for coated steel and steel reinforced concrete in water and soil.

Total 4165

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
	PROJECT AT41

FY 2001 Planned Program:

•	4204	- Develop procedures and protocol for use of ferrous shape memory alloy (SMA) rebar in concrete to provide durable, reduced cost reinforced concrete structures. - Evaluate infrastructure to support collaborative processes (e.g., engineering activities in the facility design and installation management processes) with the Modular Design System (MDS) version 3.0. - Develop design guidance for cost effective seismic rehabilitation of unreinforced masonry walls typically found at DoD installations. - Evaluate a corrosion control selection system that will assist in the proper selection and use of corrosion control materials and technologies based on site conditions and design.
Total	4204	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT42

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT42 Cold Regions Engineering Technology	4423	4516	3677	3754	3945	4142	4311	4573	Continuing	Continuing

Mission Description and Justification: This project is the only DoD applied research program focused on the knowledge base and engineering principles needed to sustain an effective war fighting force in winter and the cold regions of the world, including combat support, combat engineering and base/facility construction, operation and maintenance. Research provides the basis for extending the operability of forces and materiel in cold weather and directly lowers high life-cycle costs and extends the service life of DoD facilities. Research supports readiness and effectiveness of DoD conventional, light and special operations forces in the Arctic, Alaska, Scandinavia, Korea, Japan, Europe, the U.S. northern tier and remote/high altitude environments. This program is a source of special technologies for civilian engineering and environmental applications not obtainable through the private sector and is essential to improving projection of power and operational capabilities in cold weather areas of the world. The work is managed by the U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH.

FY 1998 Accomplishments:

- 4423 - Generated dynamic integrated IR/MMW winter backgrounds for synthetic scene simulation .
  - Developed winter effects conditions models for use in Army combat simulations.
  - Developed methods for expedient stabilization of thawing soils for theater of operations main supply route development and maintenance.

Total 4423

FY 1999 Planned Program:

- 3256 - Develop guidance for soil modifiers and geosynthetics for expedient, low-volume roads in thawing soils.
  - Identify engineering activities most sensitive to the winter environment in future combat simulations.
  - Develop finite element models of tires operating in wet, trafficked snow.
  - Develop map-based products for millimeter wave and infrared sensor performance for battlespace planning and operations.
  - Develop asphalt pavement temperature model.
- 1200 - Congressionally funded project to develop technology for detection of in-flight, aircraft icing conditions.
  - Congressionally funded project to develop technology to improve mobility and mine detection along lines of communication in cold regions.
- 60 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 4516

FY 2000 Planned Program:

- 3677 - Develop winter climate index characterization manual for snow and soil freezing effects.
  - Conduct full-scale field study on performance of soil modifiers.
  - Demonstrate application of physics-based models and visualization to support weapons selection and battle maneuver.

Total 3677

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
	PROJECT AT42

FY 2001 Planned Program:

•	3754	- Integrate multi-spectral sensor performance products into 3D terrain visualization. - Evaluate thawed soil stabilization techniques for base camps and expedient roadways. - Complete large scale ice load map/capability including accreted snow and in-cloud icing.
Total	3754	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT45

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT45 Energy Technology Applied to Military Facilities	2243	2386	2583	2796	2851	3024	3252	3464	Continuing	Continuing

Mission Description Justification: Energy is essential for the modern Army to meet its mission. The research conducted in this project provides the technology for providing energy efficient facilities, adapting new energy source technologies to military facilities, applying cost effective renewable energy technologies for Army uses, and improving the efficiency of Army central energy plants. Research focuses on leveraging industry technology investments and integrating a broad range of advanced technologies into a comprehensive system to meet the specialized needs of the Army utilities systems. Activities include modeling and simulation of thermal loops and electrical systems, developing new analytic techniques, and incorporating new system designs and hardware in conjunction with industry. Research products are transferred to the field and used in new construction and in upgrades of existing facilities. The Executive Order implementing the Energy Policy Act of 1992 requires the Army to reduce energy consumption 20% by 2001 from the 1985 baseline. New technologies and procedures also support Army goals for improved air quality, sustainable design, and expanding the use of energy savings performance contracts. This project is managed by the Construction Engineering Research Laboratories, Champaign, Illinois.

FY 1998 Accomplishments:

- 2243 - Developed methodology to optimize mix of centralized and decentralized energy supply options for Army facilities.
  - Developed application strategy for fuel cell technology.
  - Developed object/data model for use in exporting HVAC information to commercial 3-D design software.
  - Demonstrated building recommissioning at Fort Campbell, KY facilities in partnership with Louisville District Corps of Engineers.

Total 2243

FY 1999 Planned Program:

- 2386 - Complete self-tuning adaptive control algorithms for utility plant automation.
  - Develop methodology for optimizing electrical distribution and supply to Army facilities.
  - Develop concurrent engineering principles for community design concepts between electrical and mechanical building systems.

Total 2386

FY 2000 Planned Program:

- 2583 - Screening, design and application tools for hybrid cooling systems.
  - Complete design package with 3-D visualization and interference check.
  - Technical specifications for meeting utility automation goals.
  - Technology infusion process for building energy systems.
  - Process energy and pollution reduction (PEPR) program with expert system capabilities.

Total 2583

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602784A Military Engineering Technology
	PROJECT AT45

FY 2001 Planned Program:

•	2796	- Field demonstration of utility automation system. - Automate selection/design practice for hybrid cooling systems. - Field demonstration of process energy and pollution reduction (PEPR) program. - Conceptual design for regional planning tool for Army installation energy supply and demand.
Total	2796	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT46

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT46 Climate Change Fuel Cell Technology	7026	2967	0	0	0	0	0	0	0	9993

Mission Description and Justification: Funds for this project were provided by Congress in FY98 and FY99. Recent DoD demonstrations of stationary phosphoric acid fuel cells (PAFC) have shown them to be clean, reliable, efficient and high quality sources of energy. The purpose of this project is to provide additional research to reduce system capital cost, expand applications to megawatt size systems, and develop a capability to use for available fuels. This funding will increase DOD's ability to more effectively use clean and efficient combined heat and power technology and accelerate the use of fuel cell technology for military deployment and in-theater operations. The research will be jointly executed by the U.S. Army Construction Engineering Research Laboratories, U.S. Army Armament Research Development Center, U.S. Air Force Research Laboratory, and the National Defense Center for Environmental Excellence (NDCEE).

FY 1998 Accomplishments:

- 7026 - Work will continue in FY99 with FY98 funds. A test unit has been installed at NDCEE. Work will be completed in FY99 and will include:
  Address power plant system's integration for multi-unit control.
  Evaluate cost reduction for cell stack and power conditioners.
  Develop plan for field demonstration at an Army site.

Total 7026

FY 1999 Planned Program:

- 2889 - This work will build on and complete tasks initiated in FY98 to include:
  Implementing component testing at NDCEE
  Validating methods of reforming available fuels (no non-DoD fuels)
  Monitoring currently operational DoD PAFCs
- 78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2967

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT47

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT47 Molten Carbonate Fuel Cell Technology	6000	0	0	0	0	0	0	0	0	6000

Mission Description and Justification: Recent DoD demonstrations of stationary phosphoric acid fuel cells (PAFC) have shown them to be clean, reliable, efficient and high quality sources of energy. The Department of Energy (DOE) molten carbonate fuel cell (MCFC) program objectives are to develop and demonstrate cost-effective fuel cell power generation, which can be commercialized initially using natural gas fuel. The DOE program focus is on MCFC, because it offers higher efficiencies, the potential for lower capital cost, and because of higher operating temperatures, are more suitable for combined heat and power applications than PAFCs. This technology will allow an even wider application of combined heat and power technology for the modernization of decaying utility infrastructure at DoD sites. DOE, in cooperation with the Electric Power Research Institute (EPRI), Gas Research Institute (GRI), and DoD, has previously funded product development tests (PDT) concurrently with system development at the Energy Research Corporation (ERC) and M-C Power (MCP). The initial MCFC PDTs were in California in 1997. ERC conducted a 2-MW PDT in Santa Clara, California, funded by the Santa Clara Demonstration Group, EPRI, and DOE. MCP conducted a 250-kW PDT in San Diego, California, funded by DOE, GRI, and San Diego Gas and Electric at the Miramar Naval Air Station.

FY 1998 Accomplishments:

- 6000 - Work will carry-over into and be completed in FY99 with the FY98 funds and will include:
  - Modifications to cell stack, inverter, and power plant modules to reduce cost and improve performance.
  - Fuel processor modifications for alternative fuels to meet Department of Army mobility fuel requirements.
  - Developing plan for field demonstration of MCFC at an Army site.
  - Completing research efforts with two HBCU/MIs for investigating MCFC performance parameters.

Total 6000

FY 1999 Planned Program: Program not funded in FY 1999.

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT48

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT48 Center for Geosciences and Atmospheric Research	7086	0	0	0	0	0	0	0	0	7086

Mission Description and Justification: Through the Center for Geosciences and Atmospheric Research at Colorado State University, this project develops and transitions geoscience technology in hydrometeorology, cloud dynamics, remote sensing, and meteorological modeling to tri-service geosciences programs. The project impacts Army weather programs in terrain mobility and atmospheric tactical support, Air Force cloud research programs, and Navy meteorological modeling development. It provides direct support to the Defense Technology Objectives, Atmospheric Impacts on Sensors Systems, and On-Scene Weather Sensing and Prediction Capability.

FY 1998 Accomplishments:

- 7086 - Established a cooperative agreement to execute a four year research program.
  - Defined first year's goals for technology transfer and scientific exchange.
  - Established an effective transition of geosciences technology from the university to DoD labs through a program that uses but is not limited to bilateral temporary resident assignments of scientists and engineers from the university and DoD labs, extended seminar programs, and assisted software transfers.
  - Work will carry-over into and be completed in FY02 using the FY98 funds. Planned four year program will:
    - Adapt cloud drift winds model to profiler and Integrated Meteorological System (IMETS).
    - Transition neural network cloud classification system to Air Force Combat Climatology Center.
    - Adapt soil temperature and moisture remote sensing methods for incorporation into IMETS.
    - Develop cloud microphysics radiative transfer methods to mesoscale models.
    - Determine remote sensed bulk aerosol properties for visibility sensing.
    - Assess cloud forecasting capability of percentage cover of low and mid-level clouds.
    - Automate cloud drift wind determination.
    - Integrate hydrometeology and flood forecasting.

Total 7086

FY 1999 Planned Program: Program not funded in FY 1999.

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT49

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT49 University Partnering for Operational Support	0	2980	0	0	0	0	0	0	0	2980

Mission Description and Justification: This program develops and applies operational, fine-scale forecast models of basic meteorological variables for inclusion in Air Force Weather Agency (AFWA) modeling capabilities supporting Army tactical requirements. These efforts include enhancements to operational mesoscale prediction models that predict and forecast icing, turbulence, soil moisture, surface fluxes as well as chemical/biological and smoke plume dispersion.

FY 1998 Accomplishments: Program not funded in FY 1998.

FY 1999 Planned Program:

- 2902 - Develop and complete enhanced fine scale arctic weather prediction using current models upgraded for use at higher resolutions for Army applications.
  - Develop and complete improved methods of forecasting icing and turbulence for Army air operations.
  - Develop and complete improved modeling of surface fluxes and soil moisture that affect army logistics operations.
  - Develop and complete improved high latitude bio/chem plume dispersion techniques that will enhance the capability to identify and predict chemical/biological agents atmospheric flow patterns.
  - Develop and complete improvements in the atmospheric path characterization capabilities that will enhance target detection and tracking.
- 78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2980

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

PROJECT: AT50

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
AT50 Enhanced Geographic Synthetic Aperture	0	7947	0	0	0	0	0	0	0	7947

Mission Description and Justification: The program will develop and build a unique, dual frequency (X-band and P-band) airborne interferometric Synthetic Aperture Radar (SAR) and associated processing system for terrain mapping. The program will provide all-weather mapping under foliage and/or bare earth. Resulting products will enhance military operations dependent on timely, accurate, true ground surface elevation data. The effect of terrain on mobility can be evaluated more precisely with this capability. The program may yield a civil capability in land use, flood prediction, and environmental impact analyses.

FY 1998 Accomplishments: Program not funded in FY 1998 with Army funds. Program currently funded by DARPA in FY 1998 and will be transferred to the Army in FY 1999.

FY 1999 Planned Program:

- 7736 - Demonstrate and complete end-to-end product capability of X-band part of system for high resolution digital elevation model generation. X-band capability exists in current configuration.
  - Integrate P-band into the aircraft and verify operational capability.
  - Evaluate, modify, and complete upgrade of software to generate topographic products.
- 211 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 7947

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

THIS PAGE INTENTIONALLY LEFT BLANK

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602785A Manpower/Personnel/Training Technology**
	PROJECT **A790**

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A790 Personnel Performance and Training Technology	10736	8533	12071	11904	11957	11034	9736	10280	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objectives of this program are to provide the scientific basis to improve the selection and classification procedures to ensure the right person is placed in the right job, to determine leader skills and requirements for the future, to evaluate the impact of deployments on personnel issues (e.g., career commitment, retention, etc), and to provide the behavioral technologies required for the development of effective individual and collective (unit) training strategies including simulation-based synthetic environments. Research topics include training strategies for the digitized battlefield, training strategies in simulated environments, optimum designs of simulators and training devices to achieve maximum learning at minimum cost, and modernization of the selection and classification system to maintain warfighting capabilities in a downsized Army. 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 Performance and Training – Defense Technology Area. This PE is managed by the U.S. Army Research Institute (ARI) for the Behavioral and Social Sciences (ARI).

FY 1998 Accomplishments:

- 10736
  - Designed prototype training methods and performance assessment instruments for Force XXI.
  - Developed language tutor and authoring system containing continuous speech recognition to sustain highly perishable foreign language skills.
  - Developed methodology for measuring battle commander performance.
  - Established baseline measures to assess the effects of stabilizing the assignments (for 24 months) of key battalion staff members (Commander, Command Sergeant Major, Executive Officer, S3).
  - Identified factors that determine the effective mix of simulator and actual flight time for Initial Entry Rotary Wing (IERW) training to produce proficient aviators at minimal cost.
  - Developed recommendations for enhancing the effectiveness of virtual environments for soldier training.

Total 10736

FY 1999 Planned Program:

- 8385
  - Develop and evaluate prototype training and performance assessment methods for Force XXI.
  - Develop, demonstrate and evaluate instructional modules for versatile thinking skills required by brigade staff.
  - Develop performance measures of small infantry unit situation awareness linked to combat effectiveness.
  - Develop model of PERSTEMPO impacts on soldier commitment, morale and retention.
  - Assess data for longitudinal effects of stabilizing the assignments for key battalion staff members
  - Assess the impact of Land Warrior Systems on institutional training.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602785A Manpower/Personnel/Training Technology PROJECT A790

FY 1999 Planned Program: (continued)

- Implement and evaluate model IERW simulator-centered training program.
- Identify representative 21st century NCO performance requirements and attributes needed for effective performance.

Develop and implement preliminary version of a small unit leader trainer using an immersive virtual environment a testbed

•	148	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	8533	

FY 2000 Planned Program:

•	12071	- Develop training strategies on how to increase a workstation operator's capability to filter, sort, and process information derived from a complete array of data and displays. - Define characteristics of virtual environments for realistic portrayal of conditions in the dismounted soldier's environment. - Refine model of PERSTEMPO impacts on retention intentions/behavior and other human resource outcomes, based on research findings. - Complete longitudinal assessment of the effects of stabilizing the assignments for key battalion staff members. - Implement and evaluate model simulator-based advanced aircraft qualification program. - Implement and evaluate instructional feature and training strategy enhancements to the MOUT/contingency operations trainer. - Determine information display requirements to support exercise control and feedback at battalion level for the digitized battlefield.
Total	12071	

FY 2001 Planned Program:

•	11904	- Develop, demonstrate and evaluate instructional modules for versatile thinking skills required by division staff. - Document lessons learned on cognitive skill enrichment for command and staff. - Develop alternative training methods for ensuring effective performance using Land Warrior Systems. - Assess effectiveness of virtual environment (VE) interface improvements for training and mission rehearsal. - Develop preliminary training methods to enhance the processing and integration of visual, aural, and digital battlefield information by Infantry small unit leaders. - Examine simulator training task requirements for future Army aircraft. - Show relationships between 21st Century NCO attributes and performance measures. - Incorporate prototype system for computer recognition of human gestures into VE for dismounted soldier training and mission rehearsal. - Identify and define elements of human cognition and computer cognition that constitute realistic computer generated forces command entity behavior.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **2 - Applied Research**	PE NUMBER AND TITLE **0602785A Manpower/Personnel/Training Technology**
	PROJECT **A790**

Total 11904

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	8736	8602	9114	9159
Appropriated Value	9014	8602		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-278	-69		
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions				
f. Transferred from USD(HA)	+2000			
Adjustments to Budget Years Since FY 1999 PB			+2957	+2745
Current Budget Submit (FY 2000 / 2001 PB)	10736	8533	12071	11904

Change Summary Explanation: Funding: FY98 – Congressional special interest funds appropriated in the Defense Health Program were internally reprogrammed by DOD to this PE for proper program execution (+ 2000).
FY00 and FY01: 6.1 Rebaseline funding added for AAN-focused STO's: Maximizing 21st Century Soldier & Leader Performance.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602786A Logistics Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	17372	18420	23971	23405	24740	24150	22692	23927	Continuing	Continuing
AC60 AC60	2758	1948	2063	910	2097	1719	1045	1107	Continuing	Continuing
AH98 Clothing and Equipment Technology	8788	10211	14221	14524	14492	14080	14065	14831	Continuing	Continuing
AH99 Joint Services Food/System Technology	4201	4576	4864	5071	5249	5434	5388	5663	Continuing	Continuing
D283 Airdrop Advanced Technology	1625	1685	2823	2900	2902	2917	2194	2326	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element provides technology for the individual soldier and airdrop. Challenging and unique battlefield and weapons demands must be addressed by the future soldier and that soldier's support systems. In order to achieve required individual performance, mobility, and effectiveness, there must be associated technology developments evolving in soldier support equipment, supplies, and systems to make them smaller, lighter, more reliable and durable, more survivable, less manpower intensive, affordable, and more mobile. Technology efforts on clothing and equipment, cutting edge technologies for high-pressure airbeam supported shelters, and materials nanotechnology provide enhanced warfighter protection from both combat threats and from the natural field environment. Novel materials and processing techniques are being developed to provide significant weight reduction while enhancing warrior capabilities, enabling warrior system integration from the sub-microscopic level. The Joint Services Food/System Technology program 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 military food products, packaging, and combat food service equipment. Work includes the establishment of sensory quality parameters and criteria for enhancing consumption and nutrient composition, developing technologies to minimize physical, chemical and nutritional degradation of combat rations during storage, and providing for logistically effective, mobility and performance enhancing rations to meet the needs of individual soldiers in highly mobile battlefield situations. Similarly, work on advanced airdrop technology 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 as well as the need for safer, more combat efficient personnel parachutes. This is a critical capability for rapid force projection, particularly into hostile environments. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. It adheres to Tri-Service Reliance agreements on clothing, textiles, and operational rations and field food service equipment, with oversight and coordination provided by the Human Systems Reliance Panel, the Warrior Systems Technology Base Executive steering Committee, and the DoD Food & Nutrition Research & Engineering Board. There is no unwarranted duplication of effort among the military departments. Efforts are coordinated with those in PE 0603001A (Warfighter Advanced Technology). The program is managed by the U.S. Army Natick Soldier Center, Natick, MA.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602786A Logistics Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	18088	18661	19701	19456
Appropriated Value	18689	18661		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-601	-241		
b. SBIR / STTR	-105			
c. Omnibus or Other Above Threshold Reductions	-49			
d. Below Threshold Reprogramming	-562			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+4270	+3949
Current Budget Submit (FY 2000 / 2001 PB)	17372	18420	23971	23405

Change Summary Explanation: FY00 and FY01 funding increased for ballistic protection for individual soldiers and lightweight future soldier system.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602786A Logistics Technology / PROJECT: AH98

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH98 Clothing and Equipment Technology	8788	10211	14221	14524	14492	14080	14065	14831	Continuing	Continuing

Mission Description and Justification: This project provides applied research to improve soldier survivability and performance through significantly improved materials and new technology applications for combat clothing and personal equipment. Areas of emphasis include: material development to improve ballistic, flame, and directed energy protection; enhanced signature management; materials/concepts for protection in arctic, temperate, tropical, and desert environments; materials and processing techniques to enhance integration and significantly lighten the soldier's load; and three-dimensional textile techniques for achieving for rapidly deployable wide-span airbeam supported shelters. Human factors research and simulation and modeling tools applicable to the soldier system are used to quantify soldier performance and determine optimal research and development (R&D) alternatives for individual soldier items.

FY 1998 Accomplishments:

- 4841 - Demonstrated advanced materials systems for protection against combined fragmentation and small arms threats (known ball threats up to/including 0.30 caliber) at a 20-30% reduced areal density (weight) compared to current small arms protection, without significantly increasing other penalties.
  - Optimized fibers from a re-processed silkworm silk that outperformed genetically engineered silk and Kevlar fibers in toughness testing (100% tougher than Kevlar - 30% was goal). Expression level of genetically engineered silk was improved, but is no longer necessary since silkworm silk fiber is available in ton quantities (but must be re-processed) and at a lower price than a genetically engineered product.
  - Synthesized conductive polymers, using a patent pending process, applied conductive polymer coatings to nylon textiles and determined that the electrostatic dissipation of the coated textiles was greatly improved for increased safety.
  - Formulated additional thermal signature reducing facepaints and received toxicity clearance for human use by the Office of the Surgeon General; conducted small scale field experiments to determine performance levels and optimum formulations for transition into the FY99 Soldier Enhancement Program; enhanced thermal signature reducing textiles incorporating advanced countermeasure technologies for demonstration in combat clothing systems in FY99.
  - Incorporated nonlinear optical materials for laser eye protection into a polymer substrate and demonstrated optical limiting in the sample.
- 3947 - Incorporated novel flame retardant chemical additives into an extrudable nylon polymer and demonstrated the fiber production capability; synthesized novel polymers produced by enzymatic catalysis for flame retardant additives or coatings; developed topical flame retardant treatments for use on combat uniform fabrics to add flame protection to battledress systems.
  - Completed an analytic assessment of factors affecting Force XXI Land Warrior lethality that investigated operational effectiveness including: suppression; area fire; target detection; and behavioral adaptation to terrain.
  - Developed whole body scan protocols compatible with ANSUR 2-D database standards to enhance utilization of 3D scanning for design of warrior system clothing and equipment; conducted field test to obtain user feedback and verification of laboratory evaluation on biomechanically enhanced

footwear characteristics; demonstrated an eleven pound vapor compression microclimate cooling (MCC) prototype to reduce heat stress for mounted or

FY 1998 Accomplishments: (continued)

special purpose ground forces and designed a breadboard lightweight non-electric MCC prototype. MCC technology is transitioning to the Air Warrior EMD program in FY99.
- Established processes to scale-up three-dimensional textile technology to achieve seamless, large-diameter airbeams for use in highly mobile shelters.

Total 8788

FY 1999 Planned Program:

- 6826 - Transition improved small arms protective material systems to advanced development and/or as technology insertions to enhance fielded individual protective items; optimize most effective characteristics of new materials for next generation multiple ballistic threat protection (increased small arms, advanced fragmentation, and improved blast protection).
  - Measure and assess conductive polymers for electromagnetic interference shielding and anticorrosion properties; evaluate silk fiber/blend yarns and material prototypes for ballistic projectile impact properties; synthesize/obtain various nanostructures for incorporation into electrospun membranes or other nanomaterials/composites to produce lightweight materials with improved/integrated flame resistance, electostatic dissipation, comfort, ballistic and/or environmental protection.
  - Determine effects of soldiers' load volume, weight, and distribution on biomechanical performance of the soldier and validate Integrated Unit Simulation System (IUSS) soldier model predictions with these data. Demonstrate a 10-15% reduction in lower extremity disorders among ground troops wearing new biomechanically enhanced combat boots. Expand anthropometric data extraction software capabilities to include a larger number of critical body measurements required for clothing/equipment system design and evaluation.
  - Expand current physiological model capabilities from restricted laboratory settings into more representative virtual combat environments in order to more accurately simulate and assess warrior performance.
- 3273 - Execute chemical modification of novel flame retardant nylon polymer formulations to improve flammability resistance and fiber strength; demonstrate production capability of topical flame retardant treatments on combat uniform fabrics; establish performance based protection criteria for flame resistant combat clothing.
  - Demonstrate combat uniform systems technology that reduces the soldier's thermal signature by 50% from background levels.
  - Design an optical limiter that can be incorporated into a breadboard tunable laser eye protective device.
  - Demonstrate scaled up, three-dimensional textile technology using subscale prototypes that will ultimately provide highly mobile maintenance shelter capability for large weapons platforms, such as rotary.
- 112 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 10211

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602786A Logistics Technology
PROJECT AH98	

FY 2000 Planned Program:

- 5306 - Validate soldier system models using Future Warrior Architecture field and/or biomechanical laboratory data to establish the baseline for the Lightweight Soldier effort to reduce the system fighting load from current 75 lbs. to 50 lbs. Identify the most promising materials technologies for application to the lightweight soldier effort.

FY 2000 Planned Program: (continued)

- Develop improved algorithms, data model and combat vignettes for both battlefield and restricted terrain, (e.g. hallways, tunnels, trenches) to improve the accuracy of simulation based acquisition assessments of warrior systems.
- Develop processing methods to combine the most promising nanostructures into very lightweight and low bulk membranes/material/composites, without losing the individual nanostructure functionality's such as flame resistance, conductivity, comfort and environmental protection.

- 5572 - Transition to PM-Soldier technology that reduces the system weight of the individual countermine protective system (fielded in FY96) by 35%, while providing equal protection; define requirements for assessment criteria and test methodology to determine ballistic casualty reduction potential of emerging technology; evaluate novel materials/systems concepts to increase protection and reduce weight for personnel armor against emerging ballistic threats..
- Quantify the effects of load-carrying gear, clothing, and individual equipment configured for specific squad positions on human performance; complete passive dynamic gait model; support integration of automated measurement and data extraction system for human-system interface analysis and military clothing sizing and issue.

- 3343 - Scale up novel flame retardant nylon polymer formulations to production level fiber-extruding equipment and construct fabric for material testing; produce sufficient quantities of topically treated flame retardant battledress fabric for field testing; establish test methodology for flame resistant material systems.
- Optimize signature management treatments/uniforms for various soldier warrior platforms insuring significantly enhanced protection levels in their system configuration.
- Increase the level of achievable laser eye protection using polymer-based limiters.
- Optimize the wide span airbeam textile construction and fabricate a full-scale shelter module compatible with rapid deployment of large weapons platform maintenance capability objectives.

Total 14221

FY 2001 Planned Program:

- 6752 - Perform laboratory scale evaluations and demonstrations of nanotechnology composites which may be exploited for use in the lightweight soldier system architecture; develop initial virtual prototyping tool for soldier system.
- Develop and validate the capability to assess through modeling and simulation the integration of single and multiple equipment items on the individual warrior in multiple domains (lethality, survivability, mobility).
- Assess the physical/chemical properties of the lightweight, multifunctional materials produced through the use of nanostructures and nanotechnology processing methods.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602786A Logistics Technology / PROJECT: AH98

•	4750	- Determine effects of varied topographic and terrain conditions on human performance through biomechanical evaluations; extend the passive dynamic gait model to encompass terrain data; augment 3-D anthropometric scanning capabilities to include tools for applications supporting human-based modeling/simulation and novel uniform and equipment design concepts.

FY 2001 Planned Program: (continued)

		- Transition enhanced test methodology/assessment criteria for personnel armor systems to enable sound acquisition decisions with an acceptable balance of protection, weight, mobility and affordability.
•	3022	- Demonstrate 30-50% cost decrease compared to the cost of existing flame-resistant clothing systems while maintaining multiple threat protection levels. - Evaluate the unique dynamics an urban battlefield imposes on the available camouflage concealment and deception material solutions and provide optimized treatments for the urban warrior. - Modify the design of proposed millimeter-lens arrays for laser eye protection devices to decrease the length of the optical assembly to ensure human factors criteria are met. - Demonstrate the ability of an airbeam supported structure to span a cross section exceeding 60 feet in width to enable the development of a rapidly deployable large weapons platform maintenance shelter.
Total	14524	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602786A Logistics Technology	PROJECT AH99

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH99 Joint Services Food/System Technology	4201	4576	4864	5071	5249	5434	5388	5663	Continuing	Continuing

Mission Description and Justification: This DoD program, for which the Army has Executive Agency responsibility, addresses high impact, high payoff food and food system technologies to support all military Services, Special Operations Command, and the Defense Logistics Agency. Thrust areas include the applied research of combat rations, packaging, field food service equipment and combat food service systems, all of which enhance the survivability, sustainability, and supportability of the Armed Forces by ensuring optimal nutritional intake to maximize cognitive and physical performance on the battlefield.

FY 1998 Accomplishments:

- 975 - Developed concepts for storing perishable foods for field feeding to ensure food safety and reduce perishable food losses during intermittent electric power availability.
  - Tested catalytic materials, binders, pressures, and temperatures in a mini-tube fuel reformer to maximize yield of hydrogen and light hydrocarbons and completed analysis and design of autothermal reformer based fuel cell cogenerator as two approaches for converting diesel fuel into a clean burning natural gas like fuel to enable the use of commercial gas fired kitchen equipment to reduce costs and improve meal preparation, safety and efficiency.
  - Completed design of three potential micro fuel atomizers (wick, electrostatic, and microchannel) for low-output burner applications including pocket stove, microclimate cooling/heating, and power generation.
  - Developed concepts for reducing water and fuel consumption in field kitchen sanitation centers based on durable nonstick kitchen equipment coatings, distilling and recycling waste water, and reducing the number of field burners to maintain food service sanitation.
  - Prototyped and tested several designs for beverage heating including canteen cup envelope and immersion heating concepts.
- 1557 - Established cell culture and in vitro dialysis transfer methodologies that test the functional effects of nutrients for selecting most bioactive form for ration supplementation; demonstrated significant improvement of soldier performance when ingesting specific carbohydrate load; modified computerized ration design optimization model for simultaneously addressing military acceptance and cost.
  - Determined effects of food components on sleep/wake cycles to enhance combat effectiveness.
  - Evaluated novel preservation technologies and demonstrated the efficiency pH and water activity in controlling growth of microorganisms in minimally processed products for improved food safety; completed assessment of commercial technologies for biosensors for ration quality determinations; developed five new sterilized pouched entrees using irradiation processing for enhanced food safety for use by NASA and in military rations.
  - Completed study on tyrosine as a performance enhancer, showed that tyrosine improved mental alertness in cold stressed subjects, and transitioned to Demonstration and Validation (6.4) ration design and formulation programs.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602786A Logistics Technology
	PROJECT: AH99

FY 1998 Accomplishments: (continued)

- 1669 - Identified performance requirements for oxygen absorbing pouch material; developed polymeric tray barrier enhanced by glass coating for increased shelf stability and transitioned effort to Demonstration and Validation (6.4) for shelf stable rations.
  - Identified candidate films and conducted accelerated storage test on two barrier post coating systems to ensure shelf stability; transitioned system to fielded ration systems.
  - Developed four varieties of Mobility Enhancing Ration Components and field tested as part of Meal Ready to Eat (MRE) menus; transitioned components to the MRE for future menu improvements.

Total 4201

FY 1999 Planned Program:

- 783 - Complete field tests of prototype individual beverage heaters and transition to Ration Improvement Program for final development and fielding.
  - Complete testing of mini-tube and autothermal reformer critical subsystems; down-select micro fuel atomizer approaches, design and fabricate a prototype 1-2 KBTU/hr burner weighing less than 4 oz for individual soldier heat and power, and transition to Demonstration and Validation.
  - Develop concepts for a marine expeditionary field feeding system; investigate non-fossil fuel energy sources for field feeding to support Army After Next and equivalent USMC future concepts.
- 902 - Complete test and evaluation of waterless kitchen sanitation and environmentally acceptable disposal of wastewater, and transition to Advanced Sanitation Center development program.
  - Develop components and systems for reliable passive cold storage and frozen food handling systems for field kitchens to enable more fresh and frozen foods while ensuring food safety, and transition to fielded kitchen improvements development program.
  - Investigate Liquid-Injection Cogeneration (heat and electric from one process) for potential dual-use applications in military field services (kitchen, showers, laundries, space heating, etc.) and residential and light industrial energy reliance.
- 1238 - Investigate/evaluate evolving preservation technologies for ration components to exploit novel ingredients/processes for stabilizing structure and for controlling microbial growth to produce shelf stable, non-retorted ration components; optimize processing and packaging parameters for shelf-stable vegetables and fruit ration components.
  - Conceptualize the composition and configuration of a tailorable and modular combat ration, and design and test packaging concepts compatible with the tailoring of modules for either minimally or fully sustaining rations.
  - Evaluate and optimize nutraceutical products for ration supplementation to optimize combat effectiveness.
- 1621 - Optimize processing variables of non-thermal and preconcentration processes on a range of selected ration components to reduce degrative effects, cube and weight; explore synergistic combinations of new thermal (ohmic and microwave) and non thermal (high pressure) technologies to reduce overall processing and produce stable, more acceptable, “just prepared” tasting rations; develop and optimize biosensor probes for quality determination of combat rations.
  - Evaluate concepts for bioengineering of high energy ration components, incorporation of complex “nutri-fuels” into rations for improved performance, stress reduction, and protein enhancement of ration components for improved nutritional quality.

•	32	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	4576	

FY 2000 Planned Program:

•	1944	- Downselect or combine competing reformer approaches and integrate with fuel cell and kitchen thermal fluid heater; test and evaluate reformer with fuel cell and kitchen thermal fluid heater and transition to Advanced Technology Development for field kitchen technology demonstrations. - Design, fabricate, and test critical subsystems for Liquid-Injection Cogeneration including fluid, heat exchanger and expander for ultimate application to field food service equipment. - Develop concepts and identify high potential chemical subsystems for non-fossil fuel heater/chiller/electric systems for field feeding to support Army After Next and equivalent USMC future feeding scenarios.
•	928	- Complete development of miniaturized biosensor probe for food quality determination by field ration inspectors and transition to Advanced Technology Development. - Complete product development and process verification for microwave sterilized meals and transition to ration systems development program.
•	1992	- Complete studies on enhancers/antioxidants and packaging models for combat optimized ration components. - Conduct product evaluations on items produced by novel nonthermal methods for liquid removal of water in ration products. - Conduct test of engineering processes for production of carrier matrices for bioengineered protein systems for optimized future combat rations. - Complete test and selection of encapsulation methodologies/carriers for smart food components. - Conduct validation test of combat optimized ration components/supplements for suitability and acceptance.
Total	4864	

FY 2001 Planned Program:

•	1751	- Integrate and test subsystems for Liquid-Injection Cogeneration for field kitchens, and transition to Advanced Technology Development. - Design and fabricate prototype nonfossil fuel food preparing and serving systems for field feeding to support Army After Next.
•	2196	- Complete testing of combat optimized ration components and transition to Advanced Technology Development. - Complete study on engineered carrier matrices for bioengineered proteins which provide performance enhancing nutrients in a portable easily consumed acceptable form. - Complete field test of products produced with nonthermal systems for the mechanical removal of liquid which reduce ration weight, volume and total logistics costs; transition to fielded individual ration improvement program. - Fabricate prototype quality status indicators that can be monitored externally by logistics personnel.
•	1124	- Design ration packaging systems that will mimic the environment to provide a single packaging material for all rations with reduced visible signature. - Assess biodegradable materials and fabricate a prototype biodegradable carton for shipboard use.
Total	5071	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602786A Logistics Technology

PROJECT: D283

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D283 Airdrop Advanced Technology	1625	1685	2823	2900	2902	2917	2194	2326	Continuing	Continuing

Mission Description and Justification: This project provides applied research to enhance personnel and cargo airdrop capabilities. These are key capabilities for force projection, particularly into hostile areas. Areas of emphasis include parachute technology for improved performance, precision offset aerial delivery, soft landing system development, 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.

FY 1998 Accomplishments:

- 1115 - Demonstrated a gliding personnel parachute with 20% increase in maximum jump altitude and 25% increase in glide ratio as compared to the current MC-4 parachute.
  - Demonstrated a less than 10 ft/sec soft landing velocity of a 1000-lb payload using the retraction of a cluster of parachutes to allow for airdrop of critical items too fragile for airdrop with conventional systems.
  - Developed new canopy design and construction methods for a new lightweight, low bulk, low altitude, affordable cargo parachute.
  - Completed testing of the spring and magnetic air release valves for airbags for soft landing, and drive on/drive off capability.
  - Designed and constructed a pneumatic muscle for soft landing of payloads.
- 510 - Applied soft landing modeling capabilities to the Advanced Tactical Parachute System development program (personnel) and cargo systems including incorporation of a novel pneumatic muscle technology and validated results with experimentally obtained data.
  - Demonstrated and validated steady state modeling capability for a variety of parachute systems utilizing a coupled parachute model executing on DoD High Performance Computers, which will enhance the efficiency of the parachute development process.
  - Incorporated a user defined wind option into state-of-the-art parachute inflation model and performed initial simulations of parachute system wind interactions for both Army and Air Force parachute delivery systems.
  - Pursued additional partnerships with the Air Force and the parachute industry to apply government parachute system models to experimental and development programs to assist these programs and validate the models.

Total 1625

FY 1999 Planned Program:

- 1169 - Construct new prototype cargo parachutes based on the new design for a lightweight, low bulk, low altitude, affordable cargo parachute.
  - Downselect an air release valve and design and construct an airbag system prototype for roll-on/roll-off cargo airdrop.
  - Test the pneumatic muscle for soft landing of payloads.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602786A Logistics Technology
PROJECT: D283	

FY 1999 Planned Program: (continued)

- Investigate the new parafoil inflation method for cargo airdrop to increase reliability of full parafoil deployment.

• 501 - Apply state-of-the-art parachute system models to analyze performance, minimize full-scale airdrop testing and assist in design trade-off decisions. Models include: soft landing; trajectory; and guidance navigation and control models.
- Complete first generation simulations of fully coupled 3D parachute inflation model on round systems and disreefing models of cross and gliding wing systems, validate results with experimental data.
- Demonstrate parachute/wind interaction model and validate from on-going science and technology programs in the Army and Air Force.

• 15 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1685

FY 2000 Planned Program:

• 1209 - Demonstrate a smart airbag system for roll-on/roll-off cargo airdrop.
- Demonstrate soft landing of personnel by a combined parachute and pneumatic muscle system.
- Develop a concept for a pneumatic muscle soft landing system for heavy cargo using subscale testing and modeling and simulation.
- Investigate advanced, low-cost parafoil designs for improved flight and landing flare performance.

• 614 - Apply state-of-the-art airdrop system models to attempt to reduce (by as much as 10%) the life cycle costs by: minimizing feasibility testing; providing predictions of system limitations; shortening development cycle times; and predicting the effects of system modifications.

• 1000 - Develop concepts (e.g., precision and roll-on / roll-off) for development of an advanced air delivery system for the Strike Force vehicles; conduct trade-off analysis and lab testing.

Total 2823

FY 2001 Planned Program:

• 1252 - Investigate soft landing technology using a combined airbag and pneumatic muscle system.
- Design and construct a full-scale pneumatic muscle soft landing system for heavy cargo airdrop.
- Construct and test an advanced, low-cost parafoil with improved flight and landing flare performance.
- Design and test low cost, affordable precision airdrop systems.

• 648 - Incorporate additional advanced features into a second generation 3D high performance airdrop system model and validate with concurrent experimentation.
- Simulate airdrop systems of interest to DoD, transition results and package software into a user-friendly graphical user interface environment for use as an “airdrop virtual proving ground”.

• 1000 - Design and initiate component testing required for soft landing of the Strike Force Vehicle.

Total 2900

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	171362	138264	70136	68014	69125	69648	73135	76608	Continuing	Continuing
A825 Combat Maxillofacial Injury	1940	0	0	0	0	0	0	0	0	1940
A838 Neurotoxin Exposure Treatment	23420	19867	0	0	0	0	0	0	0	43287
A841 Computer Assisted Minimally Invasive Surgery	0	11425	0	0	0	0	0	0	0	11425
A843 Health Technology Roadmaps	0	1986	0	0	0	0	0	0	0	1986
A845 Bone Disease Research	0	2484	2500	0	0	0	0	0	0	4984
A869 Telemedicine/Advanced Technology	0	3341	5252	4495	4512	3332	3529	3599	Continuing	Continuing
A870 DoD Medical Defense Against Infectious Diseases	35486	23803	23794	24904	25725	26578	27965	29500	Continuing	Continuing
A872 Neurofibromatosis Research	9180	11425	0	0	0	0	0	0	0	20605
D873 HIV Exploratory Research	20414	14548	12634	11648	11095	10976	11473	11699	Continuing	Continuing
A874 Combat Casualty Care Technology	8364	10403	8580	8827	9102	9429	9896	10440	Continuing	Continuing
A878 Health Hazards of Military Materiel	7506	8671	9322	9684	9931	10240	10826	11395	Continuing	Continuing
A879 Medical Factors Enhancing Soldier Effectiveness	10530	7960	8054	8456	8760	9093	9446	9975	Continuing	Continuing
A919 Orthopedic Implant Research	2343	0	0	0	0	0	0	0	0	2343
A920 Prostate Cancer Research	37472	0	0	0	0	0	0	0	0	37472
A921 Ovarian Cancer Research	9369	0	0	0	0	0	0	0	0	9369
A927 Biocide Materials Research	5338	0	0	0	0	0	0	0	0	5338

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A948 Portable Cardiopulmonary Bypass Pump and Oxygenator	0	1986	0	0	0	0	0	0	0	1986
A949 Advanced Cancer Detection	0	3478	0	0	0	0	0	0	0	3478
A950 Teleradiology	0	2980	0	0	0	0	0	0	0	2980
A951 Diagnostic and Surgical Breast Imaging	0	1987	0	0	0	0	0	0	0	1987
A952 Musculoskeletal Injuries	0	1987	0	0	0	0	0	0	0	1987
A953 Disaster Relief and Emergency Medical Services	0	9933	0	0	0	0	0	0	0	9933

A. Mission Description and Budget Item Justification: 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. 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 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 work in this PE is consistent with the Army Science and Technology Master Plan, Army force modernization plans, and Project Reliance. This program is managed primarily by the U.S. Army Medical Research and Materiel Command.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	160376	67255	66701	67834
Appropriated Value	165484	139255		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-5108	-991		
b. SBIR / STTR	-3226			
c. Omnibus Adjustments	-1066			
d. Reprogramming from Navy	+7278			
e. Reprogramming from DHP	+8000			
Adjustments to Budget Years Since FY 1999 PB			+3435	+180
Current Budget Submit (FY 2000 / 2001 PB)	171362	138264	70136	68014

Change Summary Explanation: Funding: FY1998 – Congressional special interest funds appropriated in RDT&E, Navy (+7278) and DoD Defense Health Program (+8000) realigned to this PE by DoD Internal Reprogrammings for proper program execution.
FY 1999 – Congressional special interest funds appropriated in RDTE (+70000) and additional funding for Combat Casualty Care Technology Project 874 (+2000).

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

PROJECT: A825

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A825 Combat Maxillofacial Injury	1940	0	0	0	0	0	0	0	0	1940

Mission Description and Justification: This project is a Congressional Special Interest Research add-on for support of military dental research efforts at Great Lakes Naval Station. This project has as its major applied research thrusts of new/improved methods and materiel for rapid simplified treatment of face and neck wounds and provision of field dental treatment.

FY 1998 Accomplishments:

- 845 Developed enhanced forward/deployable dental care through smaller, lighter, and efficient dental equipment, refined contaminant controls, improved field dental restorative materials, optimized bioactive implant materials and novel agents, vaccines, and materials for dental disease/maxillofacial trauma.
- 791 Developed enhanced preventive and therapeutic dental initiatives such as novel antiplaque agents, dental sealants, and tobacco cessation programs.
- 207 Developed intraoral sensors for monitoring physiological status of warfighters.
- 97 Investigated the role of oral bacteria in neurological disease.

Total 1940

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

PROJECT: A838

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A838 Neurotoxin Exposure Treatment	23420	19867	0	0	0	0	0	0	0	43287

Mission Description and Justification: By Congressional direction, the purpose of this project is to conduct a research program on pathophysiology and treatment of neurodegenerative diseases, including Parkinson's Disease, and including environmental and stress-exposure factors encountered in military operations that may be neurotoxic or lead to neurodegenerative diseases. An improved understanding of the pathophysiology of neurodegenerative diseases will form the basis of potential preventive measures against the effects of military threat agents and military operational hazards, and also lead to treatment interventions for Parkinson's Disease.

FY 1998 Accomplishments:

- 23420 Funded a program of studies to meet these objectives by FY 2003:
  - Conduct a strong basic research program to understand the fundamental nature of neural cell death and dysfunction underlying neurodegenerative diseases.
  - Identify protective agents that may be useful in neural cell dysfunction.
  - Develop improved methods for early detection of neurodegenerative diseases.
  - Explore feasibility of new therapeutic strategies for neurodegenerative diseases involving transplantation and neuroprotection.
  - Explore feasibility of new therapeutic strategies for neurodegenerative diseases involving gene therapy and other novel treatments.
  - Investigate environmental factors that may be associated with neurodegenerative diseases.
  - Complete scientific peer review and programmatic selection of additional studies to round out the FY 1997 program portfolio.

Total 23420

FY 1999 Planned Program:

- 19341 Continue the program with awards to round out the existing portfolio.
- 526 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 19867

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

PROJECT: A841

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A841 Computer Assisted Minimally Invasive Surgery	0	11425	0	0	0	0	0	0	0	11425

Mission Description and Justification: This project funds development of minimally invasive (surgery) technologies at the Center for Minimally Invasive Technology (CMIT) (at Massachusetts General Hospital).

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

- 11123 Develop, at the Center for Minimally Invasive Technology (CMIT) at Massachusetts General Hospital, minimally invasive surgical technologies.
- 302 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 11425

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

PROJECT: A843

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A843 Health Technology Roadmaps	0	1986	0	0	0	0	0	0	0	1986

Mission Description and Justification: By Congressional direction, this program funds the creation of technology roadmaps (e.g., plans for technologies and policies) that will facilitate efficient (advanced medical) technology development, transfer, and science-technology conversion.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

- 1933 Develop, at the Department of Energy Sandia National laboratories, plans for technologies and policies that maximize the value of various outputs of advanced technology R&D programs. Develop a methodology for determining medical applications for which technology can drive down DOD medical infrastructure costs. Demonstrate cost reduction potential and information security aspects of telemedicine applications and efforts by DOD.
- 53 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1986

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

PROJECT: A845

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A845 Bone Disease Research	0	2484	2500	0	0	0	0	0	0	4984

Mission Description and Justification: This program is intended to advance bone physiology research that may lead to strategies to improve bone health of young men and women, thereby enhancing military readiness by reducing the incidence of stress fracture during physically intensive training, and reducing the incidence of osteoporosis later in life. Individual health habits that can be encouraged in young recruits may have significant effects on achievement of peak bone mineral accretion and affect other aspects of short- and long-term bone health. Understanding bone remodeling processes triggered by physical training and the relationship to injury susceptibility will reveal appropriate training and other interventions that can reduce bone injuries in military personnel. Identification of predictors of stress fracture susceptibility, efficacious interventions, and treatment strategies for susceptible and injured service members can further reduce the impact of stress fractures on readiness. The ultimate benefits of this program include establishing optimal approaches to bone health of importance to all young Americans, reduction in lost duty time from skeletal injuries, and significant medical cost avoidance for DoD and the Department of Veterans Affairs. This program fills a specific and previously neglected niche in bone physiology research, supporting a wide range of basic science through applied clinical studies on biomechanical stress on the skeleton. This is also likely to leverage related areas of importance to the military such as muscle remodeling and it supports researchers who can address other questions fundamental to bone physiology and the understanding of bone diseases; research into the pathogenesis of bone diseases substantially supports understanding of normal processes.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

- 2418 Develop the program in these six thrust areas:
  - Conduct a strong basic research program to understand the fundamental nature of mechanical influences on bone cells.
  - Develop methodology to overcome technological barriers in imaging that will enable sequential studies of functional changes in bone.
  - Define the role of bone remodeling in stress fracture pathogenesis to determine if it would be beneficial or harmful to block remodeling in recruit training.
  - Investigate interventions (e.g., calcium-nutrient drinks, weak androgens, oral contraceptives) to improve bone health in men and/or women.
  - Describe changes in bone density and health in longitudinal studies of young men and women engaged in demanding training program.
  - Investigate treatments that increase rates of healing after stress fracture.
- 66 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2484

FY 2000 Planned Program:

- 2500 Expand and continue the program in these six thrust areas:

- Conduct a strong basic research program to understand the fundamental nature of mechanical influences on bone cells.

FY 2000 Planned Program: (continued)

- Develop methodology to overcome technological barriers in imaging that will enable sequential studies of functional changes in bone.
- Define the role of bone remodeling in stress fracture pathogenesis to determine if it would be beneficial or harmful to block remodeling in recruit training.
- Investigate interventions (e.g., calcium-nutrient drinks, weak androgens, oral contraceptives) to improve bone health in men and/or women.
- Describe changes in bone density and health in longitudinal studies of young men and women engaged in demanding training program.
- Investigate treatments that increase rates of healing after stress fracture.

Total 2500

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

PROJECT: A869

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A869 Telemedicine/Advanced Technology	0	3341	5252	4495	4512	3332	3529	3599	Continuing	Continuing

Mission Description and Justification: Applied research 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). Research will focus on developing a wearable, integrated system to determine soldier physiological status. This will include developing the ability to quickly and accurately determine when a soldier is minimally impaired but still capable of functioning. By extension, work will also focus on identification and initial development of parallel and supporting technologies and systems, including telecommunications networks, teleconsultation technologies, and telerobotics.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

- 863 Modify the Land Warrior System to allow wound detection and remote triage communication between individual soldiers and the medic.
- 600 Begin to develop a prototype wearable Warfighter Physiological Status Monitoring (WPSM) system for use at the Dismounted Battlespace Battle Lab (DBBL) that has a wireless "plug and play" sensor network (activity, pulse, core and skin temperature, geolocation, metabolic cost of marching) that collects and stores information in an open, standardized format.
- 490 Continue development of an eye oximeter to assess cerebral blood oxygen content for measures of brain perfusion.
- 450 Do concept experimentation program tests at the DBBL.
- 200 Develop a portable teleradiology system to enhance diagnostic capability far forward.
- 500 Support for Joint Medical Operations-Telemedicine Advanced Concept Technology Demonstration.
- 150 Continue development of a Micro Impulse Radar which is used to assess cardiovascular function.
- 88 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3341

FY 2000 Planned Program:

- 244 Investigate accuracy and efficacy of first-generation physiological sensors to be used for far-forward diagnosis on the Land Warrior System.
- 1428 Support for Joint Medical Operations-Telemedicine Advanced Concept Technology Demonstration.
- 575 Develop intelligent instructional systems to facilitate adaptive learning of first responder diagnosis and treatment skills.
- 500 Develop first generation WPSM electronics for physiological monitoring of soldier status.

569 Interface WPSM system with Land Warrior Dead Reckoning Module to collect mission-specific physiological data from soldiers during field training exercises.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602787A Medical Technology
PROJECT A869	

FY 2000 Planned Program: (continued)

	784	Start artificial intelligence/sensor fusion protocols for WPSM to enhance diagnostic and treatment capabilities far forward.
	500	Develop first generation Warrior Medic electronics as elements for non-invasive monitoring of patient status.
	250	Demonstrate Warrior Medic medical decision assist algorithm for far-forward diagnosis and triage.
	402	Continue development of non-invasive sensors for Warrior Medic.
Total	5252	

FY 2001 Planned Program:

•	644	Continue development of non-invasive sensors for Warrior Medic.
•	780	Continue development of intelligent instructional systems to facilitate adaptive learning.
•	612	Continued development of Warrior Medic and WPSM electronics.
•	889	Utilize WPSM database, and data acquisition and management capability, to support the development and testing of modeling strategies to predict individual warfighter status.
•	770	Explore and develop a variety of medical technology overlays to tactical computing/communicating capability in order to assess performance without injury and to compare data post-injury to pre-injury.
•	800	Test artificial intelligence/sensor fusion protocols for WPSM.
Total	4495	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602787A Medical Technology

PROJECT: A870

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A870 DoD Medical Defense Against Infectious Diseases	35486	23803	23794	24904	25725	26578	27965	29500	Continuing	Continuing

Mission Description and Justification: This project supports development of medical countermeasures to naturally occurring infectious diseases, a significant threat to forces deployed outside the United States. These countermeasures will protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations.

FY 1998 Accomplishments:

- 3000 Identified a merozoite surface protein (MSP1[42]) as a candidate vaccine against the bloodstream phase of the malaria parasite, necessary for complete immune protection from malaria. Devised new *E. coli* plasmid expression systems for production of large quantities of *P. falciparum* antigens, necessary to produce reagents for evaluation of vaccine immune responses in clinical trials. Conducted study of sequestrin as a malaria immunogen in rhesus monkeys, necessary to discover additional candidate immunogens for clinical application. Collected 34 clinical isolates of *P. falciparum* as part of a library of isloates, necessary for studying genetic diversity as part of vaccine development. Implemented study of EBA-175 in 34 *Aotus* monkeys, a candidate vaccine for protection from blood-stage malaria. Began field-site development for clinical vaccine studies in Peru and Ghana. Confirmed high degree of sequence homology among malaria parasites from Indonesia compared to synthetic peptides representing potential vaccine immunogens; supports use of such peptides as vaccine immunogens. Studied several methods to augment immunogenicity of malaria DNA vaccines. Evaluated immunogenicity of "minigene vaccines" in mice as a means to induce a broad range of humoral and cellular protective responses; demonstrated protection from challenge in up to 50% of mice. Tested eight DNA vaccine candidates against *P. vivax* in *Aotus* monkeys; demonstrated immunogenicity but no protection.
- 3006 Established a repository of culture-adapted, folate-resistant *P. falciparum* field isolates as a source of material for studying the molecular basis of drug resistance and for use as test isolates in assessing efficacy of candidate antifolate drugs. Completed full-length sequencing of cytochrome b in over 30 field isolates of *P. falciparum* and discovered no naturally occurring resistance to atovoquone, a candidate drug being developed by the DoD for
treatment and prevention of malaria that will soon be approved for use, important for continuing malaria risk assessment and antimalarial drug development. Conducted in vitro drug susceptibility testing on over 3,000 candidate drug compounds, necessary for ongoing drug discovery. Discovered at least seven new classes of antimalarial drugs for further study and potential development. Demonstrated insignificant cross-resistance between mefloquine and artelinate, a new candidate antimalarial under development by the DoD, important for ongoing development of this new drug and definition of expected efficacy. Demonstrated a high-level correlation between mefloquine and desbutylhalofantrine, another candidate antimalarial, suggesting a very limited effective geographic range for desbutylhalofantrine, given the widely distributed occurrence of resistance to

mefloquine. Using quantum chemical computational methods, identified electronic properties necessary for antimalarial activity of two classes of antimalarial compounds; this contributes to discovery of new antimalarial drugs for treatment and prevention. Discovered no resistance to artemisinin among field isolates of *P. falciparum* in Thailand in ongoing surveillance for emergence of artemisinin drug resistance, necessary for further drug

FY 1998 Accomplishments: (continued)

development activities related to this class of drugs. Using polymerase chain reaction (PCR) finger printing, confirmed high rates of chloroquine resistance among clinical isolates of *P. vivax* in Indonesia; this effort is necessary for ongoing disease risk assessment. Established a clinical field site for future antimalarial drug studies in Indonesia.

- 700 Developed an enzyme-linked immunosorbent assay (ELISA) for monitoring the immune response to candidate Shigella vaccines, necessary for understanding vaccine immunity or lack thereof in clinical testing. Conducted epidemiological and natural history studies of Shigella infection among children in Egypt. Documented overall annual incidence rates of one episode for every five people per year in this population. These studies were necessary for field-site preparation for future vaccine field studies.
- 515 Demonstrated a wide range of phenotypic diversity among enterotoxigenic *Escherichia coli* (ETEC) isolates collected from Egyptian children, suggesting significant limits to the efficacy of the current candidate whole-cell ETEC vaccine, necessary for planning and designing efficacy trials of the ETEC vaccine. Demonstrated the presence, in breast milk of mothers living in ETEC-endemic areas of Egypt, of antibodies to specific virulence factors of ETEC, a prelude to studying the incidence and severity of homologous ETEC infection among breast-feeding infants. This contributed to defining and understanding correlates of immune protection from ETEC.
- 810 Based on surveillance of *C. jejuni* infection among Army and Marine personnel deployed to Thailand during training and based on virulence studies in ferrets, selected additional strains of *C. jejuni* for potential inclusion in a second-generation, pentavalent, inactivated whole-cell vaccine for prevention of *C. jejuni* infection. Began development of an ELISA for quantification and standardization of key antigen content in vaccine candidates, necessary for eventual licensure of a successful vaccine. Conducted surveillance of Campylobacter infection among children in Egypt to characterize strains of Campylobacter among clinical isolates, necessary for future field efficacy trials of candidate vaccines for prevention of *C. jejuni* infection.
- 350 Produced native and recombinant dengue antigens and attached them to platforms capable of supporting field diagnostic assay requirements. Identified field sites in Peru capable of supporting analysis of malaria diagnostic tests. Increased temperature stability of viral diagnostic reagents by lyophilizing them, demonstrating a technology that will be required in order to meet milestone exit criteria for all diagnostic devices.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602787A Medical Technology
	PROJECT A870

- 1625 Using a candidate dengue type 2 nucleic acid vaccine in nonhuman primates, demonstrated nearly complete protection from challenge after four doses of vaccine, an important step for selection of vaccine candidate. Began development of two assays (plaque reduction neutralization assay and reverse transcriptase-PCR for detection of viremia) for assessment of immune response and protection in vaccinees, necessary for future efficacy testing of candidate vaccines. Began comparative evaluation of two candidate dengue vaccines (purified, inactivated vaccine versus recombinant protein) in rhesus monkeys, necessary for selection of vaccine candidate. Began development of a dengue challenge system. Challenge strains were selected. The Food and Drug Administration (FDA) was consulted and an Investigational New Drug (IND) application was submitted. A challenge protocol was written and submitted for scientific and ethical review. These efforts were necessary for testing and down selection of a dengue candidate vaccine. Developed a neutralization test positive control reference serum with greater dengue type 4 potency, necessary for surveillance and dengue risk assessment among U.S. forces. Demonstrated hyperendemicity (0.1% of children per day) of acute dengue infection among school children in northern Thailand, necessary information for design of clinical vaccine study. Demonstrated high incidence rates of dengue among young persons in Peru, necessary for development of vaccine field testing site. Demonstrated immunogenicity in mice of a combined dengue vaccine using both recombinant protein (maltose binding protein) and a DNA vaccine expressing premembrane and envelope genes, necessary preliminary studies for selection of candidate vaccines for testing in humans.

FY 1998 Accomplishments: (continued)

- 860 Demonstrated protection from Russian spring-summer encephalitis (RSSE) and Central European encephalitis (CEE) using a naked DNA vaccine in mice, suggesting that a similar approach may be successful for tick-borne encephalitis (TBE). This is necessary if a replacement for the unlicensed TBE produced in Germany and Austria is to be developed. Began comparative study of immune responses induced by naked DNA vaccines for RSSE and CEE and by the killed TBE virus vaccine produced in Europe, necessary studies for the development of a replacement vaccine for the unlicensed European product. Demonstrated post-exposure prevention of disease due to Ebola virus in mice using two different compounds from the SAH-hydrolase family of compounds, a prelude to further studies in primates to determine potential applicability for human use. Demonstrated high prevalence (89.7%) of West Nile virus infection among Egyptian natives in two villages and documented an infection rate for West Nile virus of 39.5% among 243 U.S. personnel deployed to the Sinai, important components of disease risk assessment. Documented an infection rate of 47.6% among 308 U.S. personnel deployed to the Sinai, an important component for determining operational impact. Developed an ELISA sensitive to both prevalent strains of sandfly fever in Egypt and Jordan, an important component for further assessment of operational risk incurred due to sandfly fever.
- 530 Documented key epidemiological features of hepatitis E vaccine (HEV) at multiple field sites (China, India, Nepal, Vietnam, Indonesia, Germany, Australia, New Zealand), necessary for future field trials of candidate vaccine. Produced and distributed an enzyme immunoassay (EIA) for HEV screening of 40,000 clinical samples in Thailand and Egypt, necessary for continued sero-epidemiologic studies and risk assessment of HEV. Established purity of candidate vaccine immunogens in mice, rabbits and guinea pigs, necessary for further process development for vaccine production and for IND application. Documented moderately high prevalence of HEV antibody in Vietnam and Indonesia (21% and 11% respectively) and moderately high seroconversion rates after 2 years (5% and 6%, respectively), necessary surveillance for disease risk assessment and potential site development for future vaccine trials.

- 325 Documented human serological evidence of multiple rickettsial diseases [scrub typhus (4%), murine typhus (1%), and spotted fever (1%)] in Indonesia, necessary for disease risk assessment. Identified potential for transfusion-transmitted scrub typhus, important for disease risk assessment; this needs to be further quantified.
- 510 Demonstrated significant anti-leishmanial activity of syringomycin E, a potential new drug for treatment and/or prevention of leishmania infection. Developed and validated a new leishmania culture system for screening of candidate anti-leishmanial drugs. Developed and fielded four new target-based assays for screening of compounds for anti-leishmanial activity, necessary for discovery of new anti-leishmanial drugs. Developed processes for producing excreted antigens from Leishmania promastigotes, necessary for surveillance efforts, use as diagnostic tools, and as potential vaccine immunogens. Began efforts to produce antibodies to excreted antigens for use in development of diagnostic assays; necessary for use as surveillance and diagnostic tools. Established a sandfly infection model for Leishmania, necessary for vaccine development efforts. Established a serum archive for evaluation of potential vaccine immunogens and diagnostic tests. Established a clinical sample collection method for Leishmania, necessary for diagnosis of Leishmania.
- 260 Completed preclinical safety and immunogenicity studies of *N. meningitidis* native outer membrane vesicles (NOMV) for vaccine formulations.
- 880 Reviewed ship logs and documented 10 outbreaks and over 11,000 cases of acute gastroenteritis among sailors aboard 8 aircraft carriers from 1991 to 1994, necessary for determination of disease risk assessment of Norwalk disease and other causes of diarrhea. Documented 4 major outbreaks and the

FY 1998 Accomplishments: (continued)

epidemiology of acute gastroenteritis (principally vomiting) aboard aircraft carriers during FY 1998, necessary for risk assessment. Documented a 29% incidence of seroconversion with antibody to Norwalk virus among 200 randomly selected sailors with diarrhea during a routine deployment that strongly suggests that Norwalk virus is a major cause of acute gastroenteritis among military populations. Developed a model that identifies probable

locations of the sandfly which transmits both Leishmania and sandfly fever. Validated the model with sandfly collection at one of the predicted sites, potentially useful in predicting disease risk during deployments. Studied clinical cases of hemorrhagic fevers, encephalitis and hepatitis among pediatric patients in Cambodia; documented that Japanese encephalitis accounted for only 10% of encephalitis among patients, important for understanding and defining new potential risks for encephalitis among deployed U.S. personnel. Documented high rates (83 of 109 patients) of Shigella dysentery among hospitalized patients with bloody diarrhea in Kenya, indicates a significant risk for disease among personnel deployed to Eastern Africa. Documented resistance to Fansidar among 35% of clinical malaria isolates in Kenya. Documented moderately high prevalence of antibodies to multiple Rickettsial diseases (Ehrlichiosis, Q-fever and spotted fever group) in Brazil. Documented reemergence of dengue in Manaus, Brazil (40% of 5,534 clinical samples tested). Established real-time computer surveillance network for infectious disease reporting in eight hospitals in Indonesia. Evaluated a rapid diagnostic test strip in Indonesia for use in field diagnosis of HIV, syphilis and hepatitis B.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602787A Medical Technology / PROJECT: A870

- 1350 Evaluated repellency of three candidate compounds for replacement of DEET, showed equivalency or slightly superior repellent properties of one compound (AI3-37220). Demonstrated efficacy of the lethal ovitrap at reducing dengue vector (*Aedes aegypti*) populations at 2 sites in Brazil. Demonstrated the ability of the "Combined Wicking" assay for detection of malaria and dengue antigens, potentially useful for far forward detection of infected mosquitoes and risk assessment by deployed forces. Developed PCR primers for detection of all 4 dengue strains in infected mosquitoes, potentially useful for targeting vector control measures to prevent malaria among deployed U.S. personnel. Conducted arthropod surveys in Northern Africa to help prepare field sites for future repellent testing. In vector studies of several species of sandfly, discovered that *Phlebotomus sergenti* and *P. langeroni* may be important vectors of *Leishmania tropica*, necessary to determine optimal vector control measures.
- 300 Explored mechanisms of synthesis of bacterial, viral and parasitic antigens, necessary for process and manufacturing development for pilot production of vaccine and other biologics for research and field use.
- 11055 Paid administrative overhead costs at the Walter Reed Army Institute of Research (WRAIR).
- 9410 Paid transition costs of moving the WRAIR into a new facility.

Total 35486

FY 1999 Planned Program:

- 3190 Complete construction of specially designed amino acid transport proteins (derived from rare codon transfer RNA plasmids) that permit high expression of malaria proteins in the *E. coli* expression system. Use this system for production of malaria-specific reagents to analyze immune responses to vaccines. Demonstrate feasibility of immunization against *Plasmodium vivax* using a viral replicon system.
- 1050 Express and purify recombinant proteins of at least five different target proteins for structure-based drug design of novel antimalarial drugs. Expand existing capabilities to screen antimalarial drugs by developing new animal models. Analyze the antimalaria activity of novel candidate compounds. Analyze surveillance data and draft a report for Commanders in Chief on the threat of drug-resistant malaria to military operations worldwide,

FY 1999 Planned Program: (continued)

including recommendations for prophylaxis against malaria and treatment of soldiers with malaria and for monitoring treated soldiers to ensure they have been cured. Develop tests to monitor the development and spread of drug-resistant malaria.

- 495 Produce purified Shigella vaccine candidate antigens based on the virulence protein epitopes identified in FY 1998. Prepare and submit IND application supporting trials of a live-attenuated *Shigella sonnei* vaccine. Evaluate the safety and efficacy of combined *S. flexneri* 2a and *S. sonnei* vaccine in animal models.
- 906 Clone genes encoding three ETEC colonization factor antigens into Good Manufacturing Practice (GMP)-suitable expression vectors for testing as possible vaccine candidates to stimulate protective mucosal antibodies. Characterize human mucosal immune responses to ETEC infection by quantifying serum and luminal antibody responses after ETEC infection in a challenge protocol. Assess role of newly identified ETEC toxins as virulence factors in E. coli-mediated diarrheal disease.

- 864 Determine safety, efficacy and optimal dose schedule of an attenuated live or carrier-based Campylobacter vaccine in animal models. Produce and characterize recombinant Campylobacter proteins identified as a result of FY 1998 6.1 research effort to select those most relevant to protective immunity. Determine feasibility of developing monkey model to assess combined Campylobacter, Shigella and ETEC vaccine efficacy. Determine optimum methods for industrial-scale growth of Campylobacter strains for vaccine production.
- 191 Produce malaria and hantavirus diagnostic devices under GMP conditions. Reengineer a Campylobacter diagnostic test and perform initial kit evaluations. Identify appropriate field sites for testing the malaria, Campylobacter and hantavirus diagnostic tests. Integrate specimen collection component into nucleic acid detection platform.
- 1531 Evaluate safety and immunogenicity of candidate recombinant, DNA, and killed dengue vaccines in animals.
- 793 Evaluate safety of candidate replicon vaccines for Lassa Fever and Congo Crimean Hemorrhagic Fever (CCHF) virus in animals. Develop and validate a rodent model for evaluation of TBE vaccines and therapies. Evaluate safety and immunogenicity of a naked DNA vaccine against TBE in an animal model. Conduct efficacy trial of monoclonal antibody immunotherapy against CCHF and Lassa virus in monkeys.
- 649 Determine feasibility of potential components of future diagnostic tests for hepatitis E. Characterize T-cell responses involved in the pathophysiology of HEV.
- 396 Clone genes from antibiotic-resistant scrub typhus organisms to develop and define genetic markers and mechanisms of antibiotic resistance. Establish archive of antibody and antigen-positive sera for scrub typhus diagnostic assay development.
- 123 Conduct preclinical animal studies with new lots of an outer membrane protein vaccine for prevention of group B meningococcal infection.
- 540 Expand disease surveillance worldwide locations and networks and complete threat assessment report concerning any new significant threats of military importance to deployed soldiers. Characterize the new infectious agents and determine if a specific research effort on that agent must be considered.
- 1025 Test a method for controlling sand flies in the Middle East by distributing insecticide-treated baits. Clone a drug-resistant strain of *Plasmodium vivax* malaria in culture.
- 91 Explore novel and improved methods of vaccine production and adjuvant research at the Vaccine Pilot Production Facility.

FY 1999 Planned Program: (continued)

- 500 Provide and publish a detailed assessment of the threat of hantaviruses to military operations. Demonstrate efficacy of candidate vaccines in preclinical studies for one or more of the pathogenic Hantaviruses.
- 11056 Pay administrative overhead costs at WRAIR.
- 403 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 23803

FY 2000 Planned Program:

- 3713 Develop standardized methodologies including ELISA, proliferative assays, enzyme-linked immunosorbent spot test (ELISPOT) assays, and other methods of reliably measuring immune responses. Conduct preclinical studies of candidate vaccines to support sections 7 (Chemistry, Manufacturing and Control) and 8 (Pharmacology and Toxicology) of an IND application. Develop a method to perform CONUS-based *P. vivax* sporozoite challenge. Conduct preclinical studies of candidate combined *P. falciparum* and *P. vivax* vaccine.
- 802 Perform chemical synthesis or isolate from natural products candidate antimalarial drugs. Identify techniques for the cultivation and drug sensitivity testing of vivax malaria. Employ molecular modeling to design antimalarial drugs. Identify, clone, and express target proteins for structure-based drug design and determine modes of action and resistance of antimalarial drugs. Create a deployable field test to assay drug sensitivity patterns in malaria based on enzymatic, colorimetric, probe or micro-array technologies. Conduct target-based and whole organism screening systems for assaying activity or determining cytotoxicity candidate drugs. Conduct assays to discover synergistic drug combinations or resistance modulator drugs. Create computer systems to analyze, merge, and compare physicochemical and biological data. Maintain a drug repository to include acquisition, storage and distribution. Prepare radiolabeled drug candidates for preclinical studies of drug distribution, pharmacokinetic and metabolism. Prepare gram and kilogram quantities of drug candidates under Good Laboratory Practice (GLP)/GMP. Perform preclinical toxicology studies of new drugs. Prepare drug delivery systems of compounds under GLP/GMP. Conduct a surveillance program for drug-sensitivity patterns of malaria from diverse geographic regions.
- 670 Modify candidate live vaccines to reduce reactogenicity and/or excretion while retaining efficacy. Modify candidate live vaccines to support rapid identification of excreted organisms. Modify candidate vaccines to enhance efficacy. Devise polyvalent vaccines using live *Shigella* carrier(s) or subcellular protein carrier(s).
- 787 Determine and characterize relevant ETEC virulence factors. Develop expression vectors for relevant ETEC antigens. Enhance mucosal immune responses by microencapsulation and adjuvant technologies. Develop an improved animal model for ETEC infection. Develop a multivalent vaccine to include protection against enteric pathogens in addition to ETEC. Improve methods to diagnose ETEC infections.
- 759 Explore new and/or improved animal models of *Campylobacter enteritis* and immunity, including the ferret, the pig, and nonhuman primates. Develop improved diagnostics utilizing either antigen detection or nucleic acid based tests.
- 138 Develop infectious disease-specific reagents for a portable device capable of detecting and identifying nucleic acids by integrating four separate processes: specimen processing, amplification of gene targets, detection of product or signal, and simplified data analysis. Devise specimen processing methods that allow the purification of target nucleic acids in less than 30 minutes. Develop reagents for malaria, enteric diseases, dengue viruses, and the hemorrhagic fever viruses. Identify unique gene amplification primers and probes. Identify multiple gene targets per agent.

FY 2000 Planned Program: (continued)

- 1702 Ascertain whether immunity to premembrane envelope protein generated by “dead” or DNA vaccine is a sufficient basis for immunization of humans of diverse genetic backgrounds. Validate measures of T-cell memory and assess their relevance to immunity against disease. Validate a method for quantitation of “enhancing” antibodies. Characterize the host and virus determinants of severe dengue disease (plasma leakage, hemorrhage, liver injury, central nervous system injury). Determine the feasibility of second generation live vaccines (engineered attenuation, made from infectious clones, higher yield cell substrate, etc.).

- 675 Assess mechanisms of pathogenesis to include viral-specific events and non-specific factors including cytokines and coagulation factors in animal models of viral hemorrhagic fever (VHF) and encephalitis. Develop candidate vaccines for VHF and encephalitis agents in appropriate animal models. Evaluate antiviral drug candidates for efficacy in vitro and in animal models. Develop and evaluate primate monoclonal antibodies for protective efficacy in animal models including primates. Improve capability to rapidly identify these agents in the field and to provide definitive confirmation in reference labs.
- 430 Establish level of antibody that prevents disease. Refine characterization of human T-cell responses to HEV infection, disease, and vaccine. Refine epidemiology of HEV and virus phylogenetic analysis in Asia and Africa. Sustain or refute presence of hepatitis E disease among humans in Latin America using virus detection as basis for diagnosis. Characterize animal reservoir (particularly rodents) and animal HEV isolates.
- 479 Establish the degree of immunologic heterogeneity among available *Orientia* isolates. Define a set of *Orientia* isolates that exhibit little or no cross-protection against heterologous challenge in mice. Clone and sequence appropriate strain-specific antigens from appropriate noncross-protective isolates for use in the development of a polyvalent scrub typhus vaccine. Characterize, maintain and use a scrub typhus-infected chigger colony to evaluate scrub typhus vaccines for use as a challenge in a mouse or primate protection model.
- 100 Identify and genetically modify candidate vaccine strains to maximize expression of desirable antigens and minimize expression of undesirable antigens. Complete animal immunogenicity and safety studies to determine the optimal parameters for use in vaccine production, presentation, and formulation. Conduct a detailed serological analysis of the animal and human immune responses to the vaccines to determine which antigens are the most immunogenic, and to determine the capacity of induced antibodies to kill group B strains of different subtypes. Determine the importance of the iron uptake proteins and the Opc outer membrane protein (OMP) in the vaccines by analysis of the antibody response of animals and humans. Identify and genetically modify additional vaccine strains representing other prevalent OMP subtypes and lipooligosaccharide (LOS) immunotypes. The immunogenicity of these additional vaccine strains should be determined in animals.
- 35 Conduct surveillance to identify emerging pathogens that place deployed soldiers at risk for febrile illnesses, respiratory disease, encephalitis, diarrhea, hemorrhagic fever and other conditions.
- 926 Establish a standard insecticide resistance and susceptibility test at each laboratory, choose a group of local vectors to be tested each year (to include *Aedes aegypti*, where available), and perform trial tests. Evaluate the threat of tick and chigger-borne diseases to the U.S. military. Begin development of a dengue vector control system, an integrated system of tools and information that can be physically packaged for a Preventive Medicine Detachment (or service equivalent): (1) perform thorough evaluation of components necessary for the system, including those which remain to be developed; (2) prepare a trial device for evaluating pools of vectors for presence of virus; and (3) establish basic research on new devices for evaluating biting rate and distribution of vectors. Conduct preliminary development of devices and techniques that may serve as components of a vector control system for malaria vectors, including a field device for detecting *Plasmodium* in vectors.

FY 2000 Planned Program: (continued)

- 1112 Devise processes for manufacture of at least 10 new vaccine lots under cGMP compliance.

- 410 Develop and test in animals a candidate vaccine to one or more hantaviruses, assessing immune responses and protection. Improve capability to rapidly identify, assess risk, and formulate control strategies for hantaviruses, including: (1) developing new techniques to detect hantaviruses; (2) evaluating therapeutic reagents (e.g., human monoclonal antibodies, or antivirals) for hantaviruses and test in cell culture and animals; (3) isolating and characterizing novel hantaviruses.
- 11056 Pay administrative overhead costs at WRAIR.

Total 23794

FY 2001 Planned Program:

- 4028 Express proteins encoded by the *P. vivax* gene homologs of the *P. falciparum* candidate vaccine components. Test their immunogenicity in an animal model. Develop field sites for *P. vivax* human vaccine trials.
- 1576 Develop a field site for testing a drug for treatment of multidrug-resistant malaria.
- 712 Complete animal trials of candidate *S. dysenteriae* vaccines. Characterize proteins identified through genomic sequence data analysis to verify their possible application to vaccine development. Construct candidate polyvalent Shigella vaccines and screen for immunogenicity in an animal model.
- 897 Characterize the optimal formulation of the ETEC components of the combined enteric vaccine. Prepare field sites for the evaluation of the candidate ETEC microencapsulated vaccine.
- 784 Characterize the immune responses associated with recovery from Campylobacter infection and subsequent protection.
- 231 Design an automatic reporting system that can detect positive agent identification within 30 minutes, for the nucleic acid identification platform. Transition the malaria and dengue nucleic acid primers and probes onto the nucleic acid identification platform.
- 1841 Develop a cytotoxic T-cell technology to evaluate dengue vaccine candidates.
- 624 Design generic hemorrhagic fever intervention strategies to interrupt vascular endothelial cell infection and ultimate hemorrhage, applying results of preceding 6.1/6.2 pathogenesis studies.
- 363 Assess the threat of hepatitis E to U.S. service members in Africa and Latin America.
- 420 Demonstrate the feasibility of immunologic protection against scrub typhus in an animal model and demonstrate efficacy of a candidate scrub typhus vaccine in an animal model.
- 534 Genetically alter the antigenic composition of a group B meningococcal candidate vaccine strain to enhance the ability to propagate it.
- 171 Identify vertebrate hosts for hemorrhagic viruses determined to pose a threat to U.S. service members.
- 640 Develop a rapid immunological method for detecting Leishmania infected sand flies. Test a synthetic replacement for the insect repellent DEET. Determine a strategy to render the *P. falciparum* multidrug-resistant gene ineffective.
- 781 Develop an improved ferret animal model to assess LTR192G-adjuvanted enteric vaccines, to increase predictive ability of side effects in human clinical studies.

FY 2001 Planned Program: (continued)

- 246 Transition to advanced development a multivalent Hantavirus vaccine to prevent infection with viruses causing hemorrhagic fever with renal syndrome (HFRS) or hantavirus pulmonary syndrome in immunized personnel.

•	11056	Pay administrative overhead costs at WRAIR.
Total	24904	

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602789A Army Artificial Intelligence Technology

PROJECT: A880

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A880 Army Artificial Intelligence Technology	764	1156	1276	1346	1380	1418	1532	1606	Continuing	Continuing

A. Mission Description and Budget Item Justification: The goal of the Intelligent Technology (IT) applied research program is to mature emerging intelligent and advanced information technology for future insertion into Army applications to achieve the strategic advantage needed to perform the Army's world-wide missions. The threefold purpose of the program is to: (1) develop/apply emerging intelligent technology to solve large scale, highly complex management problems; (2) apply emerging intelligent technology to solve Army-wide problems in policy, personnel training and management, and applications development; and (3) transfer technology to the Army through exploratory development efforts. In addition, the program seeks to identify high potential, but embryonic intelligent methodologies and mature them for high payoff applications through targeted technology demonstration projects and the development of working models. This program has established a number of sophisticated IT cells (knowledge engineering groups (KEGs)) focusing on the integration and application of intelligent technologies to problems in functional communities such as command and control, management, force integration, logistics, modeling, intelligence, resource management, test and evaluation, training, and medical. Focus for this science and technology effort is assisted through these functionally oriented cells. In addition, an office of Artificial Intelligence (AI) research, analysis and evaluation has been established at the United States Military Academy to conduct AI applications research and development. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI. This program is overseen by the U.S. Army AI Program General Officer Steering Committee (GOSC) and is managed primarily by the US Army Strategic and Advanced Computing Center, Pentagon.

FY 1998 Accomplishments:

- 764 - Demonstrated use of intelligent technologies in integrating vastly different data and technologies to solve highly complex problems.
  - Demonstrated effectiveness of AI and information technology to manage information overload.
  - Investigated AI based prognostics technology for logistics and maintenance.

Total 764

FY 1999 Planned Program:

- 1125 - Demonstrate use of knowledge management and emerging intelligent technologies in integrating vastly different data and intellectual capital to solve highly complex problems.
  - Demonstrate effectiveness of hybrid systems within manufacturing and the knowledge management domains.
  - Demonstrate integration of hybrid systems within synthetic environments for command and control AI systems.
  - Demonstrate the integration of hybrid systems for the testing and evaluation of IT systems.
  - Demonstrate the effectiveness of IT based prognostics systems in achieving “just-in-time” supply and maintenance.
- 31 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1156

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602789A Army Artificial Intelligence Technology / PROJECT: A880

FY 2000 Planned Program:

- 1276 Demonstrate applications of intelligent technologies with emphasis in the application of knowledge management and practices to the force structure, personnel, logistics, maintenance, modeling and simulation, and medical domains.

Total 1276

FY 2001 Planned Program:

- 1346 Demonstrate applications of intelligent technologies with emphasis in the application of knowledge management and practices to the force structure, personnel, logistics, maintenance, modeling and simulation, and medical domains.

Total 1346

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	1205	1164	1206	1260
Appropriated Value	1255	1164		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-50	-8		
b. SBIR / STTR	-31			
c. Omnibus or Other Above Threshold Reduction	-10			
d. Below Threshold Reprogramming	-400			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+70	+86
Current Budget Submit (FY 2000/2001 PB)	764	1156	1276	1346

Change Summary Explanation: Funding – FY98: Funds reprogrammed (-400) for other high priority requirements.

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

DATE: February 1999

BUDGET ACTIVITY: 2 - Applied Research

PE NUMBER AND TITLE: 0602805A Dual Use Applications Program

PROJECT: A105

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A105 Dual Use Application Program	0	9935	18222	18217	18120	18175	18548	18926	Continuing	Continuing

A. Mission Description and Justification: The goal of the Dual-Use Applications Program (DUAP) is to provide an incentive for Army agencies to exploit new ways of doing business with the private sector in the development of technologies having both military and commercial applications. This PE provides matching funds to those invested by the sponsoring agencies on projects proposed by the private sector. Private sector partners propose projects for which they are willing to invest at least half of the cost (i.e., $\geq$ 50%). The sponsoring agency then provides half of the government cost ($\leq$ 25%), with the remainder coming from this PE ($\leq$ 25%). The cost-sharing by industry is intended to demonstrate their willingness to share in the development costs for items having substantive commercial applications. The cost sharing from this PE is intended to incentivize Army agencies to participate in the dual-use effort and to exploit new instruments (i.e., Other Transactions) for partnering with the private sector. The program exploits dual-use opportunities in a number of areas of significant interest to the Army, including automotive, rotorcraft, communications, sensors, medical, construction, environmental, food, clothing, and logistics technologies. This program provides significant savings to the Army, both in terms of initial development costs and, due to the parallel commercial products, reduced costs for end items. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI. This program is overseen by the Office of the Secretary of Defense (OSD) Dual-Use Steering Committee and is managed primarily by the Office of the Deputy Assistant Secretary for Research and Technology. Prior to FY1999, DUAP was funded by DARPA.

FY 1998 Accomplishments: Program funded by a Defense Advanced Research Projects Agency (DARPA) PE.

FY 1999 Planned Program:

- 9672 - Provide up to 25% of funding for dual-use technology projects proposed by industry to meet Congressionally mandated goal of 7% of Army 6.2 funding being allocated to support dual use technology development. Focus areas for Army topics in FY99 are: Affordable Sensor Technology; Aircraft Sustainment; Fuel Efficiency and Advanced Propulsion Technology; Information Systems and Technology; and Medical Technologies.
- 263 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 9935

FY 2000 Planned Program:

- 18222 - Provide up to 25% of funding for dual-use technology projects proposed by industry to meet Congressionally mandated goal of 10% of Army 6.2 funding being allocated to support dual-use technology development. Specific projects to be supported in FY00 will be identified by June 1999.

Total 18222

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY: 2 - Applied Research	PE NUMBER AND TITLE: 0602805A Dual Use Applications Program / PROJECT: A105

FY 2001 Planned Program:

- 18217 - Provide up to 25% of funding for dual-use technology projects proposed by industry to meet Congressionally mandated goal of 15% of Army 6.2 funding being allocated to support dual use technology development. Specific projects to be supported in FY01 will be identified by June 2000.

Total 18217

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	0	20000	18700	18750
Appropriated Value		10000		
Adjustments to Appropriated Value				
a. Congressional General Reductions		-65		
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reduction				
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-478	-533
Current Budget Submit (FY 2000/2001 PB)	0	9935	18222	18217

Change Summary Explanation; Funding – FY 1999 – Program reduced by Congress (-10000).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	33126	30430	31287	16337	17868	14523	20218	21312	Continuing	Continuing
DC07 Joint Service Food Technology Demonstration	1718	1959	2072	2168	2219	2295	2322	2457	Continuing	Continuing
DJ50 Force XXI Land Warrior	10582	6891	6305	6335	7526	7835	13086	13217	Continuing	Continuing
D242 Airdrop Equipment	1178	1255	1886	3141	3434	3576	3833	4025	Continuing	Continuing
D393 Military Operations in Urban Terrain	18976	19538	20240	3898	3884	0	0	0	0	66969
D543 Ammunition Logistics	672	787	784	795	805	817	977	1613	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program supports demonstration of technology for the dismounted soldier and materiel essential to support and sustain wartime operations and peacetime readiness, both strategically and tactically. The program's purpose is to develop, demonstrate, and transfer affordable technologies to enhance dismounted soldier system performance and capabilities, reduce the logistics burden on the battlefield, reduce operation and support (O&S) costs, and improve ammunition logistics system performance. It links diverse projects by applications benefiting whole categories of weapons systems and providing high return on investment. The Joint Service Food Technology project demonstrates food service systems and food products, processing, preservation, and serving equipment resulting from technology programs jointly approved by the Services and the Defense Logistics Agency (DLA) that will improve field feeding efficiencies, ration quality, and warfighter combat effectiveness. Force XXI Land Warrior develops and demonstrates advanced technology components for insertion into the Land Warrior program and performs the integration of future soldier system technologies focused on improving soldier performance, lethality and survivability. Enhancements to airdrop equipment for rapid deployment are required for dropping cargo to precise locations from higher altitudes, greater offset distances and higher speeds, resulting in increased survivability of aircraft and crews and increased probability that materials delivered will land in a usable condition. The Military Operations in Urban Terrain (MOUT) ACTD will identify, integrate, and demonstrate a system of systems approach of existing and emerging technologies to provide improved command, control, communications, computers, and intelligence (C4I), engagement, and force protection for Soldiers and Marines operating in the restrictive urban environment. The Ammunition Logistics project 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. Contractors performing the work for this PE include Motorola, Raytheon, Honeywell, Gentex, Battelle, Arthur D. Little, Tecogen, Pioneer Aerospace, Giordano Automation, and InterVision. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. This program adheres to Tri-Service Reliance Agreements on clothing, textiles and food and explosive ordnance disposal with oversight and coordination provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with efforts in PE 0602786A (Warfighter Technology), and DARPA Small Unit Operations projects. The Ammunition Logistics project is related to PE 0602624A (Weapons and

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603001A Logistics Advanced Technology

Munitions Technology) and PE 0603004A (Weapons and Munitions Advanced Development). These efforts contain no unwarranted duplication of effort among the Military Departments.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	34361	32969	30376	14445
Appropriated Value	35469	30669		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1108	-239		
b. SBIR / STTR	-853			
c. Omnibus or Other Above Threshold Reductions	-282			
d. Below Threshold Reprogramming	-100			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+911	+1892
Current Budget Submit (FY 2000 / 2001 PB)	33126	30430	31287	16337

Change Summary Explanation: Funding - FY00 and FY01 increased to support MOUT ACTD interim capability for a battalion (vice a company).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: DC07

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DC07 Joint Service Food Technology Demonstration	1718	1959	2072	2168	2219	2295	2322	2457	Continuing	Continuing

Mission Description and Justification: Joint Service Food is a DoD program, for which the Army has executive agent responsibility, which demonstrates nutritionally advanced rations and logistically streamlined food delivery systems to sustain DoD personnel in all operations and to enhance their combat performance under diverse battlefield scenarios. The project focuses on demonstrations of advances in food technology, materials, energy utilization, and combination heating technologies to provide extended, simplified field feeding without resupply. It exploits advances in ration formulation and quality, packaging, preservation, and nutritional content to improve morale, extend endurance, and sharpen mental acuity. This project is managed by the U.S. Army Natick Soldier Center, Natick, MA.

FY 1998 Accomplishments:

- 874 - Completed technology demonstration of four new mobility enhancing ration components and transitioned to fielded individual ration program.
  - Completed product/process development phase for multibarrier processing of marine products and transitioned to fielded field rations program.
  - Conducted field test of carbohydrate performance enhancement drink (ERGO) and transitioned to procurement; transitioned performance enhancing HOOAH bar to procurement.
  - Conducted producibility testing and field evaluation of horizontal-form-fill-seal pouch and polymeric tray and transitioned to fielded group ration systems program.
- 844 - Demonstrated prototype heat-driven refrigerator and transitioned to Demonstration and Validation (6.4) phase; pursued thermophotovoltaic (TPV) power cogeneration and developed concepts for field kitchen applications based on ongoing work with portable power generators but TPV heat rejection was insufficient for kitchen application.
  - Developed concept for a light and efficient future field feeding system based on engine cogeneration and thermal fluid heat transfer with potential for upgrade with Liquid-Injection cogeneration as technology matures in Applied Research.

Total 1718

FY 1999 Planned Program:

- 1168 - Complete design and fabricate prototype highly efficient, highly mobile Central Heat Unit Cogeneration Kitchen featuring thermal fluid heat transfer and integral cogenerator.
  - Demonstrate Central Heat Unit Cogeneration Kitchen's increased mobility (HMMWV vs. 2 ½ ton), 50% decrease in fuel consumption, 50% increase in MTBF, ease of use, and ability to prepare higher quality meals faster and cheaper than current kitchens; transition technology to Demonstration and Validation Phase for technology integration in both the Containerized Kitchen-Future, and the Kitchen, Company Level Field Feeding-Future.

- 766 - Demonstrate producibility of interactive packaging technologies and quantify the effects of interactive packaging on improving ration acceptance and consumption while decreasing weight/volume of package rations; transition to DLA.

FY 1999 Planned Program: (Continued)

- Model the effects of incremental differences in carbohydrate sources on mission effectiveness and completion.
- Demonstrate shockwave technologies for processing that improve texture of meat items for combat rations.
- Identify commercial and developmental items and initiate acceptance and storage testing to support a family of breakfast items for on-demand combat field feeding.

- 25 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1959

FY 2000 Planned Program:

- 422 - Conduct testing to determine optimal storage conditions, dosage levels and optimal delivery systems to provide fresh fruits and vegetables with extended shelf life for ships at sea.
- 1650 - Conduct studies on optimization of ration processes to improve quality and reduce cost.
- Complete field demonstration of radio frequency processed ration components and coordinate with FDA and USDA for regulatory process approval.
- Complete demonstration of interactive packaging technologies and transition to fielded ration systems.
- Complete product acceptance and shelf life studies on family of breakfast items for combat rations, complete menu design.
- Complete demonstration and quality assessment of irradiated foods with enhanced safety.

Total 2072

FY 2001 Planned Program:

- 1073 - Integrate fuel reformer, fuel cell, and thermal fluid heat exchanger in field kitchen and conduct technology demonstration.
- Design prototype system for extended shelf life of fresh fruits and vegetables, conduct user testing, and transition to procurement.
- Investigate new types of chemical heaters with higher energy densities, lower cost and inherent safety which will be used to develop an integral or readily attachable self-heating ration system.
- Design, fabricate, and test cold storage temperature stabilization system and transition to Demonstration and Validation.

- 1095 - Conduct user/field testing of portable biosensor system transitioned from Applied Research and transition to Veterinary Command.
- Complete study on packaging requirements for family of breakfast items and conduct field demonstration.
- Conduct initial field demonstration of radiant barrier packaging system for freeze/thermal protection of ration components.

Total 2168

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603001A Logistics Advanced Technology	PROJECT DJ50

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DJ50 Force XXI Land Warrior	10582	6891	6305	6335	7526	7835	13086	13217	Continuing	Continuing

Mission Description and Justification: This project addresses the critical Army need to enhance the performance, lethality, survivability, and sustainment of the individual soldier. This project is the Land Warrior science and technology (S&T) program. In the near term, the Force XXI Land Warrior focuses on near-term technology insertions to the Land Warrior system. These technologies include: enhanced weapon mounted sensor interfaces to increase reliability, reduce weapon weight and increase usability, an integrated navigation component that will provide soldier's accurate geo-location information when GPS is not available, enhanced soldier radio which will provide a better link margin for the soldier radio and increase radio range, system voice control which will provide voice control of the essential Land Warrior functions without the use of a hand control device, combat identification functionality which will provide positive ID of friendly Land Warrior and non-Land Warrior combatants, low power helmet electronics which will reduce the overall power requirements of the Land Warrior helmet system, and a head orientation sensor which in combination with weapon mounted sensors will provide a rapid target acquisition capability when switching between the image intensifier and the weapon sight. Another Force XXI Land Warrior component is the Integrated Sight Technology Demonstration (TD), which will demonstrate a lighter, fully integrated weapon sensor (uncooled thermal, laser pointer, laser range finder, digital compass, daylight camera), with integrated target handover functions. Integrated technology demonstrations utilizing surrogate equipment in lieu of the Land Warrior system will demonstrate the improved individual and small unit operational effectiveness afforded by the modular integration of advanced components onto the Land Warrior platform. These results will be utilized to ensure that future Land Warrior procurements are upgraded with current technological advancements. Force XXI Land Warrior will also pursue a variety of future technology developments (from ongoing Defense Technology Objectives, Science and Technology Objectives, and DARPA programs) to chart a course for future Land Warrior modernization by focusing on technologies available for fielding beyond the FY06 timeframe. The focus of these improvements will be system weight reduction, minimization of system power and energy requirements, system life cycle cost reduction, and improved system fightability. This program will leverage the commercial microelectronics and telecommunications industries as well as other ongoing DOD programs such as DARPA's Small Unit Operations (SUO) program to achieve lightweight, miniaturized components. This project is managed by the US Army Natick Soldier Center, Natick, MA.

FY 1998 Accomplishments:

- 1710 - Completed design and fabrication of two Integrated Sights used by Armor Center for mounted warrior concept evaluation program.
  - Built and delivered two Integrated Sight thermal components and delivered to the Objective Individual Combat Weapon program for integration onto the weapon system.
- 3792 - Created the Future Warrior Architecture team to track future technology developments for inclusion into future Land Warrior system/block upgrades.
  - Created and populated the Warrior Systems Modernization Strategy database that provided the S&T and EMD communities an integrated planning tool for future upgrades to the Land Warrior system as well as to other warrior systems (e.g., Mounted, Air and enhanced systems).
- 5080 - Completed development of the enhanced weapon interface and performed proof of concept demonstration.

- Completed development of the system voice control system and performed proof of concept demonstration; technology has been accepted by the user, is being included in the operational requirements document (ORD), and is being included as part of the baseline Land Warrior system.

FY 1998 Accomplishments (Continued):

- Completed development of the Land Warrior Combat Identification (ID) functionality. Proof of concept demonstration delayed until FY99 due to lack of Combat ID components from the Combat ID Engineering, Manufacture and Development (EMD) program.
- Completed development of the enhanced soldier radio. Proof of concept demonstration delayed due to a delay in getting the Land Warrior radio for comparison demonstration.
- Completed development of the integrated navigation component and performed proof of concept demonstration; technology has been accepted by the user, is being included in the ORD, and is being included as part of the baseline Land Warrior system.

Total 10582

FY 1999 Planned Program:

- 4891 - Assess and develop future technology insertions into the Land Warrior system.
  - Build Land Warrior surrogate systems for the conduct of the Integrated Technology Demonstrations (ITDs).
  - Build system voice control, integrated navigation, combat ID, enhanced soldier radio, and integrated sight components for the ITD, with some functionality limitations due to use of surrogate systems.
- 1845 - Perform ITD of upgraded Land Warrior (surrogate) systems.
  - Prepare transition documents for other successful technologies.
  - Demonstrate future component integration onto the Land Warrior (surrogate) platform.
  - Complete initial elements of the Future Warrior Architecture trade study.
- 155 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 6891

FY 2000 Planned Program:

- 4075 - Upgrade seven Land Warrior systems with system voice control and integrated navigation upgrades.
  - Transition system voice control and integrated navigation to the Land Warrior EMD program.
  - Complete Future Warrior Architecture trade study.
  - Identify DARPA Small Unit Operations (SUO) technologies for potential Land Warrior upgrades.
- 2230 - Participate in the Military Operations in Urban Terrain (MOUT) ACTD Advanced Concept Excursion (ACE) with upgraded Land Warrior systems.
  - Develop a Land Warrior interface with the Objective Individual Combat Weapon (OICW).
  - Develop transition documents for the transitioning of MOUT/OICW related technologies onto the Land Warrior system.

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603001A Logistics Advanced Technology**

Total 6305

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603001A Logistics Advanced Technology
	PROJECT DJ50

FY 2001 Planned Program:

- 3235 - Integrate advanced technology upgrades (e.g., Javelin integration, medical monitoring, low power electronics and software, and advanced antennae), into Land Warrior systems and demonstrate and assess for future technology insertions into the Land Warrior system.
  - Perform user evaluations of upgraded systems.
- 3100 - Perform experiments with emerging technologies from the Lightweight Soldier S&T program and related efforts to validate performance on Land Warrior systems.
  - Baseline performance of production quality Land Warrior systems to aid in technology investment decisions.

Total 6335

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: D242

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D242 Airdrop Equipment	1178	1255	1886	3141	3434	3576	3833	4025	Continuing	Continuing

Mission Description and Justification: This project focuses on the demonstration and development of equipment and innovative techniques for aerial delivery of cargo and personnel, a key capability for rapid force projection, particularly into hostile areas as envisioned in Vision 2010. The goal is precision delivery of payloads from extremely high altitude (up to 25,000 ft) and long offset distances. Delivery from high altitudes and large offset distances improves cargo/personnel and aircraft survivability. In the near-term, revolutionary technologies for the reliable precision guided delivery of combat essential munitions/sensors and equipment using high glide wing technology will be demonstrated which incorporate a low cost, modular global positioning system (GPS) guidance package and control system. Specific near-term goal is a system capable of a 2,000-5,000 lb. payload, a glide ratio of at least 6:1, and an optional glide augmentation system with a range of 75-300 km.

FY 1998 Accomplishments:

- 1178 - Completed fabrication of High Glide Air Delivery prototypes.
  - Conducted extraction test from USAF aircraft.
  - Conducted testing of glide augmentation system.

Total 1178

FY 1999 Planned Program:

- 1233 - Conduct flight testing of High Glide Air Delivery System for use in Air Delivery of cargo from an offset range of 75-300 km.
  - Conduct demonstration of precision high glide of a 2,000 lb. Payload with a goal of 5,000 lb. payload using an advanced guidance package and high glide wing.
- 22 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1255

FY 2000 Planned Program:

- 1886 - Fully define required technologies and establish concept development strategies for parachute and harness systems for high altitude, high offset, precision airborne insertions into restricted terrain.
  - Conduct field and market surveys to identify known deficiencies with current equipment and target technologies which will address these deficiencies while advancing the state-of-the-art.
  - Develop test and evaluation methods and strategies; explore low cost, yet highly reliable data collection equipment and devices for measuring parachute and harness system performance.
  - Develop canopy guidance and navigation methods/algorithms; perform concept evaluations of user interface/MANPRINT issues.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603001A Logistics Advanced Technology
	PROJECT D242

Total 1886

FY 2001 Planned Program:

- 3141 - Complete concept evaluation of personnel-sized parachute high glide decelerator technology.
  - Conduct flight testing and performance measurement of promising parachute designs and technologies; explore and evaluate methods for improving canopy control techniques.
  - Fully quantify canopy performance in full glide and in full brakes; identify stall characteristics of high glide and precision landing canopies; explore methods for integrating these distinct canopy design methods without compromising performance.
  - Validate canopy flight guidance and navigation methods through actual flight testing.

Total 3141

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603001A Logistics Advanced Technology	PROJECT D393

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D393 Military Operations in Urban Terrain	18976	19538	20240	3898	3884	0	0	0	0	66969

Mission Description and Justification: This project conducts the integration of technology products into a "System of Systems", develops of operational concepts and tactics/techniques/procedures (TTPs), and executes live experiments and simulations to determine the military utility of various technologies in enhancing operational capabilities in the urban environment. The Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstration (ACTD) will integrate promising Commercial-off-the-Shelf (COTS), Government-off-the-Shelf (GOTS) products and technology products from on-going Army, Marine Corps and Defense Advanced Research Projects Agency (DARPA) programs to create the MOUT System of Systems. The objective is to improve the command, control, communications, computers and intelligence (C4I), engagement, force protection and mobility capabilities of soldiers and Marines, and ensure the effective interoperability of these capabilities in the particularly challenging urban environment. The program will transition to rapid and efficient acquisition and fielding of the value-added components following the completion of the ACTD culminating demonstration in FY2000. Hardware successfully demonstrating capabilities will be provided to operational units as an interim capability, including follow-on support, during FY2001/2002. The MOUT ACTD is a joint Army/Marine Corps program with participation from DARPA. This project is managed by U.S. Army Natick Soldier Center, Natick, MA.

FY 1998 Accomplishments:

- 10327 - Developed the initial MOUT systems architecture.
  - Completed engineering characterization of technology products in the MOUT environment for ten MOUT ACTD requirements.
  - Conducted integration, interoperability assessments, and diagnoses of mature technology products from the Army, Marine Corps, DARPA, COTS, and GOTS.
  - Identified models and simulations to assess and quantify military utility and force effectiveness of hardware and software in MOUT.
- 8649 - Planned, managed, coordinated, and executed the MOUT ACTD program.
  - Procured prototype hardware and software for use in MOUT experiments.
  - Conducted baseline MOUT experiments (Army #1-3, USMC #1&2) at Fort Benning and Camp Lejeune.
  - Conducted squad/platoon MOUT experiments (Army #1-3, USMC #1&2) of mature technologies at Fort Benning and Camp Lejeune.

Total 18976

FY 1999 Planned Program:

- 9138 - Implement integration, interoperability assessments, and diagnoses of technology candidate products for the systems of systems.
  - Conduct modeling and simulation to quantify military utility of advanced technology hardware and software.
  - Assess MOUT operational concepts and Tactics, Techniques and Procedures to determine effectiveness of new capability employment.
- 10400 - Manage, coordinate, and execute the MOUT ACTD program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology / PROJECT: D393

- Procure additional prototype hardware and software for use in MOUT experiments.

FY 1999 Planned Program: (continued)

- Conduct transition assessments of successful technologies.
- Complete follow-on squad/platoon level MOUT experiments with prototype hardware.
- Conduct joint MOUT company level experiments to ensure integration and interoperability of MOUT ACTD hardware and software.

Total 19538

FY 2000 Planned Program:

- 7193 - Manage, coordinate and execute MOUT ACTD program
- Complete integration/modifications resulting from joint company experiments.
- Conduct force effectiveness analyses to determine higher echelon impacts of individual soldier/small unit MOUT improvements.
- 13047 - Complete New Equipment Training (NET) package and conduct NET.
- Deliver culminating demo hardware.
- Conduct Advanced Concept Excursion to identify MOUT potential of emerging technologies.
- Conduct MOUT ACTD culminating demonstration at Joint Readiness Training Center.
- Finalize technology transition assessments.

Total 20240

FY 2001 Planned Program:

- 1745 - Complete transitions of successful MOUT ACTD technologies to Army acquisition programs.
- Conduct extended military utility and technical analyses and assessments of residual hardware.
- Refurbish ACTD residual hardware
- Transition residual hardware to Army and USMC experimental forces units.
- 2153 - Provide technical/engineering operations for residual hardware during extended evaluation phase.

Total 3898

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: D543

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D543 Ammunition Logistics	672	787	784	795	805	817	977	1613	Continuing	Continuing

Mission Description and Justification: This project develops technology that maximizes munitions availability and survivability for the force projection Army. It enhances logistics survivability and force readiness through improvements in explosive safety, materiel handling equipment, ammunition and missile packaging/palletization, and asset throughput/management. It also improves weapon system rearm for artillery, armor, air defense, aviation, and infantry. Emerging technologies and productivity enhancers/cost savers are exploited to provide quantum improvements to the force projection (strategic), in-theater (operational), and combat-focused (tactical) logistics systems. 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 and the Total Army Distribution System.

FY 1998 Accomplishments:

- 672 - Defined specifications for shock attenuation and fire blocking characteristics of a rapidly deployable barrier and fire blocking system that mitigates propagation of explosions and fire between open stacks of munitions in forward storage areas.
  -Conducted small scale experiments to verify shock attenuation and fire blocking characteristics of the rapidly deployable barrier and fire blocking system.

Total 672

FY 1999 Planned Program:

- 766 - Conduct full scale testing of a prototype rapidly deployable barrier and fire blocking system that improves the survivability of munitions storage areas and personnel.
  - Prepare data package for the rapidly deployable barrier and fire blocking systems.
- 21 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 787

FY 2000 Planned Program:

- 784 - Design and fabricate a prototype sensor and passive (battery-free) transceiver unit that will be embedded in advanced munitions for the AAN Combat Vehicle armament system to provide asset visibility and expenditure rates for anticipatory resupply as well as internal temperature data used by the fire control system to improve armament system accuracy.
  - Develop a modular munitions packaging/logistics system concept for autonomous resupply/rearm of the AAN Combat Vehicle in the field to reduce the logistics tail, greatly decrease rearm burden, and allow the AAN Combat Vehicle more time on station.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology
	PROJECT: D543

FY 2000 Planned Program: (continued)

- Design and fabricate a prototype battery powered Micro-Electro Mechanical Systems (MEMS) based environmental sensor suite that will be attached to munitions or munitions packaging to provide remote tracking of munitions "health" status for improved stockpile management/readiness and Total Asset Visibility.

Total 784

FY 2001 Planned Program:

• 795
- Integrate discrete components and conduct full scale testing and demonstration of the embedded passive sensor for AAN Combat Vehicle munitions.
- Design conceptual munitions resupply module for the AAN Combat Vehicle armament system.
- Integrate individual MEMS based environmental sensor devices (shock, humidity, temperature, barometric pressure, etc.) into a single chip system that is attached to munitions or munitions packaging and demonstrate remote tracking of munitions health status and logistics data.

Total 795

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	202504	229325	10539	12591	13566	14957	19391	20858	Continuing	Continuing
D800 Telemedicine Testbed	0	0	0	1866	1669	0	2948	3433	Continuing	Continuing
D804 Prostate Cancer Research	0	49669	0	0	0	0	0	0	0	49669
D806 Breast Cancer Research	126469	134107	0	0	0	0	0	0	0	260576
D810 Industrial Base/Infectious Disease Vaccines and Drugs	7752	8480	7932	8096	8678	9147	9703	10216	Continuing	Continuing
D815 National Medical Testbed	7495	7947	0	0	0	0	0	0	0	15442
D818 Advanced Cancer Detection Center	3270	0	0	0	0	0	0	0	0	3270
D819 Field Medical Protection and Human Performance Enhancement Non-Systems - Advanced Development	0	0	200	194	557	576	618	647	Continuing	Continuing
D840 Combat Injury Management	3252	2450	2407	2435	2662	5234	6122	6562	Continuing	Continuing
D922 Emergency Telemedicine	2343	0	0	0	0	0	0	0	0	2343
D923 Prostate Diagnostic Imaging	4683	7450	0	0	0	0	0	0	0	12133
D924 Advanced Trauma Care	2810	0	0	0	0	0	0	0	0	2810
D929 Artificial Lung Technology	1405	845	0	0	0	0	0	0	0	2250
D930 Cooperative Teleradiology	2810	0	0	0	0	0	0	0	0	2810
D932 Periscopic Minimally Invasive Surgery	16000	0	0	0	0	0	0	0	0	16000
D933 Proton Beam Therapy	4000	0	0	0	0	0	0	0	0	4000

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D934 Volume Angiocat	3747	3974	0	0	0	0	0	0	0	7721
D937 Nervous System Studies	4468	0	0	0	0	0	0	0	0	4468
D938 Tissue Engineering	3500	0	0	0	0	0	0	0	0	3500
D939 Medical Imaging	3500	0	0	0	0	0	0	0	0	3500
D940 Epidermolysis Bullosa	1000	0	0	0	0	0	0	0	0	1000
D941 Diabetes Research	4000	4470	0	0	0	0	0	0	0	8470
D954 Digital X-Ray	0	3973	0	0	0	0	0	0	0	3973
D955 Assistive Technology	0	5960	0	0	0	0	0	0	0	5960

A. Mission Description and Budget Item Justification: This program element funds advanced technology development for the DoD core Vaccine and Drug Program, field medical protective devices, and combat injury management. These last two projects focus on diagnostic imaging devices, clinical studies of combat casualty care treatment modalities, and nutrition and soldier performance enhancement. 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. 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. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This program is managed primarily by the U.S. Army Medical Research and Materiel Command. This program element also serves to track funds for Congressionally directed medical research in projects 806, 815, 818, 922, 923, 924, 929, 930, 932, 933, 934, 937, 938, 939, 940, 954, and 955.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	176737	11012	10788	10977
Appropriated Value	190177	230862		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-5471	-1537		
b. SBIR / STTR	-4305			
c. Omnibus or Other Above Threshold Adjustments	+22103			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-249	1614
Current Budget Submit (FY 2000 / 2001 PB)	202504	229325	10539	12591

Change Summary Explanation: FY1998 Appropriated Value - Funding increased for new Congressionally directed projects. Funding was also affected by several reprogrammings of Congressional special interest funds for proper program execution. FY 2001 funding increase (+1614) for telemedicine ACTD (Project 800).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D800

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D800 Telemedicine Testbed	0	0	0	1866	1669	0	2948	3433	Continuing	Continuing

Mission Description and Justification: This project funds development, evaluation, and demonstration of prototypes of advanced technologies that will incorporate health awareness into battlespace awareness, provide force protection, reduce time to critical intervention for injured personnel, improve the skills and proficiency of medical personnel, and improve the quality of emergency and surgical care throughout the battlespace. Key objectives are to demonstrate capabilities for real-time monitoring and assessment of soldiers, remote identification of injured personnel, simulations for training of medical personnel, and decision support and remote intervention for medical personnel.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program:

•	1866	Develop and test a seamless telemedicine network that connects health care providers in the front lines with tertiary medical treatment centers through the Joint Medical Operations - Telemedicine Advanced Concept Technology Demonstration.
Total	1866	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D804

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D804 Prostate Cancer Research	0	49669	0	0	0	0	0	0	0	49669

Mission Description and Justification: By Congressional direction, the purpose of this project is to continue the peer-reviewed Prostate Cancer Research Program.

FY 1998 Accomplishments: Project not funded in this PE in FY 1998.

FY 1999 Planned Program:

- 48353 Published a Program Announcement in December 1998. Conduct scientific peer review and programmatic review for training grants by April 1999 and make initial awards by May 1999. For Prostate Cancer Center grants, conduct scientific peer review by September 1999. Conduct programmatic review in October 1999 and make initial awards by December 1999. For idea grants, conduct scientific peer review and programmatic review by August 1999 and make initial awards by September 1999. All awards will be finalized by 30 September 2000.
- 1316 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 49669

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D806

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D806 Breast Cancer Research	126469	134107	0	0	0	0	0	0	0	260576

Mission Description and Justification: By Congressional direction, the purpose of this project is to continue the peer-reviewed Breast Cancer Research Program.

FY 1998 Accomplishments:

- 126469 Published a Program Announcement in March 1998. Conducted scientific peer review and programmatic review by December 1998 and make initial awards in January 1999. Complete awards no later than 30 September 1999.

Total 126469

FY 1999 Planned Program:

- 130555 Publish a Program Announcement in March 1999. Conduct scientific peer review and programmatic review by November 1999 and make initial awards in December 1999. All awards will be completed by 30 September 2000.
- 3552 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 134107

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology	PROJECT D810

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D810 Industrial Base/Infectious Disease Vaccines and Drugs	7752	8480	7932	8096	8678	9147	9703	10216	Continuing	Continuing

Mission Description and Justification: This project funds development of medical countermeasures for naturally occurring diseases that are militarily significant due to their potential impact on military operations. Development of medical countermeasures will protect the force from infection and sustain operations by preventing hospitalization and evacuations from the theater of operations. Major contractors are the University of California, San Francisco, CA; SRI, Inc., Menlo Park, CA; Starks Associates, Inc., Buffalo, NY; ASH Stevens, Inc., Detroit, MI; and Research Triangle Associates, Research Triangle Park, NC.

FY 1998 Accomplishments:

- 1660 Began study of "prime-boost" (prime immune system using a DNA vaccine and boost the immune system with a protein vaccine) vaccine system in Rhesus monkeys to attempt to enhance the poor antibody response typically seen with DNA vaccines, necessary study for selecting the best vaccine strategy. Began preclinical studies of *P. falciparum* TRAP immunogen combined with RTS,S vaccine in attempt to enhance vaccine-induced immune response to include phases of the parasite life cycle. In developing a *Plasmodium knowlesi* (Pk)/Rhesus monkey model for testing a DNA vaccine, sequenced, constructed and injected into monkeys four Pk genes, necessary for demonstrating safety and immunogenicity and for defining details of dosing, schedule, route, adjuvants, and vaccine delivery of a DNA vaccine. Immunogenicity and protection studies are ongoing. Tested 10 DNA vaccine candidates for *P. falciparum* in mice, *Aotus* and Rhesus monkeys for their ability to induce antibodies against blood-stage forms of the malaria parasite, necessary for finalizing the blood-stage DNA vaccine "cocktail." Completed the first Phase 1 clinical trial of a *P. falciparum* DNA vaccine candidate, demonstrating vaccine safety and the ability to induce T cell immune responses, necessary clinical study for continued development and evaluation of DNA vaccines. Began a Phase 1/2a clinical trial of a five-gene DNA vaccine for prevention of malaria caused by *P. falciparum*, necessary clinical study for continued development and evaluation of DNA vaccines. Conducted epidemiological studies of *P. falciparum* malaria among Thai military forces on the Thai-Burmese border, necessary for continued disease risk assessment and for preparation for vaccine and drug studies. Developed clinical trial site for malaria vaccine trials in Kenya. Demonstrated significant genetic heterogeneity in the TRAP and CS genes among clinical *P. falciparum* isolates in Kenya, which suggests that a vaccine based on the current TRAP protein may be less effective in protecting individuals from malaria parasites in Kenya. This is important for designing and developing an effective malaria vaccine. Identified and characterized four potential field sites for malaria vaccine testing in Peru, necessary preparation for future malaria vaccine field trials. Identified a field site for malaria vaccine and drug trials in Indonesia consisting of nonimmune transmigrants, necessary for establishing comparative efficacy of malaria vaccines between persons who have never been exposed (nonimmune) versus those with a history of previous infection ("immune").
- 2029 Identified and analyzed four metabolites of artelinic acid metabolism in humans and produced three of them in sufficient quantity and purity for assessment of activity and toxicity, studies necessary for a complete assessment of the metabolism and toxicity of this candidate antimalarial drug prior to submission of a New Drug Application (NDA). Demonstrated that the presence of active infection with malaria does not alter the pharmacology or antimalarial activity of arteether or dihydroqingaosu, necessary to understand the potential for toxicity or loss of drug activity that

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology
	PROJECT D810

FY 1998 Accomplishments: (continued)

may occur due to effects of infection on drug metabolism. Identified new field sites in Thailand for clinical testing of candidate antimalarial drugs. Collected 70 new clinical pediatric malaria isolates for use in drug susceptibility screening, necessary for ongoing surveillance of drug resistance and disease risk assessment. Established laboratory capacity for polymerase chain reaction (PCR) analysis of malaria isolates for markers of drug resistance, necessary for ongoing studies of the dynamics of drug resistance as a part of new drug development. Completed a clinical trial of WR6026, a candidate drug for treatment of systemic leishmaniasis. Demonstrated limited efficacy and the occurrence of kidney toxicity in three patients, which may limit further development of WR6026.

- 384 Studied safety and immunogenicity of human administration of *S. flexneri* 2a SC602 candidate vaccine to 33 subjects in an outpatient, Phase 1 clinical trial. Demonstrated safety in all volunteers with only 6 subjects (18%) experiencing fever or diarrhea and seroconversion in 60% of subjects, a necessary study for transition of candidate vaccine to advanced development.
- 413 Using current Good Manufacturing Practice (cGMP), produced 100 master seed vials and 100 production seed vials of enterotoxigenic *Escherichia coli* (ETEC) strains B7A and H10407 for challenge studies, necessary for future clinical studies of ETEC vaccines. Developed clinically relevant ETEC challenge model using ETEC strains B7A and H10407 at a dose of 10^{10} colony forming units/dose, necessary for future clinical studies of candidate ETEC vaccines. Established radiolabeled polynucleotide hybridization probe assay in Peru for detection of ETEC toxins in stool samples for support of surveillance and epidemiological studies and in support of future ETEC vaccine trials. Evaluated over 500 stool samples from diarrhea patients in Peru for the presence of ETEC; detected ETEC in 12%. This demonstrated a significant prevalence of ETEC in the community and contributed to ongoing surveillance and disease risk assessment. Conducted epidemiological studies of ETEC infection in Egypt. Documented 1.43 episodes of ETEC infection per person per year, studies necessary for clinical field site development for future ETEC vaccine trials.
- 433 Developed an experimental model of human *C. jejuni* infection, necessary for future studies of immune response and protection induced by candidate vaccines for *Campylobacter jejuni*. Conducted testing on 250 stool samples obtained from soldiers and marines with diarrhea incurred during deployment to Thailand. Demonstrated 10% of cases to be associated with Campylobacter infection. These efforts were necessary for continued surveillance and disease risk assessment. Conducted clinical evaluation of "E-Test strips" for diagnosis of Campylobacter antibiotic resistance among soldiers and marines deployed to Thailand. Demonstrated comparable performance compared to traditional, time-consuming methods. This method may be adaptable to facilitate surveillance and disease risk assessment. Conducted surveillance and natural history study of Campylobacter enteritis among soldiers and marines deployed to Thailand. In 156 cases of diarrhea, there were 26 isolates of Campylobacter, 35 of ETEC, 34 of enteropathogenic *E. coli* (EPEC), and 42 of *Salmonella* species. All Campylobacter isolates were ciprofloxacin resistant. These studies were necessary for disease risk assessment and for preparation for vaccine trials in this population.
- 283 Completed initial field evaluation of a commercially produced hand-held dengue diagnostic assay in concept evaluation phase (CEP). Tests on 80 documented positive and 17 documented negative patients in Indonesia showed that the hand-held assay exceeded sensitivity and specificity of the current reference laboratory diagnostic method. Completed initial field CEP evaluation of one commercially produced hand-held malaria diagnostic assay on patients in Indonesia with initial results showing very high sensitivity. Completed a limited field trial in Peru to evaluate the sensitivity of two commercially produced hand-held malaria diagnostic assays in detecting *P. vivax*. Enrolled over 3,000 volunteers in Peru and Thailand and completed 80% of testing in an expanded comparison of the malarial diagnostic assay candidates to demonstrate performance characteristics on different types of malaria worldwide. This comparison is critical to ensure that we will be able to detect malaria infection in our servicemembers despite parasite variability throughout the world.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology
	PROJECT D810

FY 1998 Accomplishments: (continued)

- 796 Evaluated protective efficacy of a recombinant vaccine against dengue type 2 in a cynomolgous monkey model. Results suggested that this vaccine is immunogenic but protection could not be determined from this model. An alternate species of monkey was proposed for future studies. Evaluated safety, immunogenicity, and protective efficacy of a DNA vaccine against dengue type 1 in Rhesus and Owl monkey models, comparing intradermal and intramuscular vaccine delivery with and without vaccine boosts. Both of these monkey models were very effective. These trials provide the first evidence of feasibility of DNA vaccines to protect against dengue infection and demonstrated that the vaccine was well tolerated, stimulated substantially increased antibody production after boosts and with intradermal delivery and was 30% protective. Completed two Phase 1 safety and immunogenicity trials of a live tetravalent dengue vaccine (dengue types 1, 2, 3 and 4) in 4 and 32 volunteers, respectively. These preliminary data suggest that this live vaccine is safe and more than 50% immunogenic. The second trial compared vaccination boosts at 1 and 3 months and showed that a second dose at either time interval increased the immune response significantly and to a similar extent. These results provide initial feasibility to support the overall objective of protecting servicemembers against all four types of dengue virus with a single vaccine. Identified two suitable cohorts in Thailand, one possible cohort in Indonesia and two possible cohorts in Peru with suitable dengue infection rates to support future vaccine field trials. It is important to be able to conduct field vaccine trials at geographically diverse locations throughout the world to ensure protection against antigenically distinct forms of the virus.
- 136 Completed 60% of a clinical study to determine the efficacy of the antiviral drug ribavirin to treat sandfly fever virus infection in human volunteers.
- 62 Identified potential cohorts in Nepal with high hepatitis transmission rates suitable for Hepatitis E vaccine field trials, which are necessary to meet milestone 0 exit criteria.
- 106 Conducted studies in Thailand to identify ecology of scrub typhus. Analysis of 1,433 rodents and over 30,000 chiggers resulted in the identification of a new ecological habitat of rice agricultural areas, for *Orientia tsutsugamushi*, the organism that causes this disease. Knowledge of high risk areas for infection is important in protecting deployed troops. Developed and tested an immunocytochemical method to detect *O. tsutsugamushi* in chigger vectors and found it to be useful and sensitive. Modified a commercially available *O. tsutsugamushi* diagnostic kit so that it would be capable of identifying wild mammalian reservoirs of this organism. This mammalian test will allow medical personnel to monitor troop areas and assess whether there is risk for human scrub typhus infection.
- 56 Identified populations endemic for leishmaniasis in Brazil and Bolivia and set up field sites for evaluations of rapid leishmania diagnostic tests. Trained research scientists in those remote locations on reference diagnostic test procedures that will be necessary as a standard for comparison of the rapid tests. An additional potential feld site was identified in Kenya.
- 258 Prepared and characterized a second clinical lot of Native Outer Membrane Vesicle (NOMV) Group B Meninogoccal intranasal vaccine. This second lot was reproducible to the first in all aspects except for a lower pH and resulting decreased solubility. This study resulted in a recommendation to modify the production procedure to include buffering agents. All vaccine characterization data were forwarded to the Food and Drug Administration (FDA) along with a copy of the approved clinical protocol as an amendment to the Investigational New Drug (IND) protocol #6993. Evaluated mucosal immune response to intranasal vaccination with NOMV Group B Meningococcal vaccine as part of a Phase 1 clinical trial and found that this vaccine and route of immunization stimulates both serum and mucosal antibodies. The possibility of stimulating mucosal immune response is

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology
	PROJECT D810

FY 1998 Accomplishments: (continued)

attractive as it provides an additional tier of defense not afforded by traditional vaccination methods. In support of CEP vaccine candidate comparison, prepared and obtained approvals for clinical protocol for Phase 1 safety and immunogenicity study of a second Group B Meningococcal vaccine candidate consisting of outer membrane proteins and detoxified lipooligosaccharides (OMP-dLOS).

- 229 Compared effectiveness of DEET repellency in men versus women. Found that DEET has a shorter duration of effectiveness in women, suggesting the need for a change in doctrine directing women to reapply repellent more often (every 6 hours versus every 8 hours for men). Measured the effect of battle dress uniform abrasion on DEET-treated skin. BDU rubbing on the skin reduced the protective efficacy of DEET from 10 hours to less than 3 hours. Resistance to uniform abrasion is a significant factor that needs to be considered in future repellent formulations.
- 907 The Pilot Bioproduction Facility at Walter Reed Army Institute of Research produced under Good Manufacturing Practices (GMP) pilot lots of vaccines and other biologicals of sufficient quality for Phase 1 human trials, to include: Four lots of Japanese encephalitis purified-inactivated vaccine, two lots of dengue type-2 purified-inactivated vaccine, one lot of Shigella intranasal proteosome, one lot of Meningitis Group B proteosome, six lots of HIV skin test peptides, one lot of scrub typhus diagnostic antigens, and one lot of leishmania skin test antigen. This facility is a unique asset that provides the GMP-quality products that are critical for progression from basic research to advanced development.

Total 7752

FY 1999 Planned Program:

- 1516 Refine methods to measure immune responses to *Plasmodium falciparum* RTS,S and TRAP proteins to support Phase 1 trials of new formulations of combined vaccines containing both of these antigens. Identify correlation between specific immune antibody and cellular responses and protection against malaria in human volunteers. Conduct Phase 1 trial of new *Plasmodium falciparum* MSP-1 vaccine candidate.
- 2971 Complete all remaining studies on the leading antimalarial compound necessary to obtain FDA approval for an IND application that permits evaluation of a new and improved drug to prevent malaria in humans.
- 486 Submit IND application to the FDA for trials of combined live, oral *Shigella flexneri* 2a and *Shigella sonnei* vaccines. Conduct Phase 1 dose selection testing of the combined *Shigella flexneri* 2a and *Shigella sonnei* vaccine. Perform a challenge trial of a *S. sonnei* vaccine. Perform field trials with the *Shigella* PCR diagnostic device.
- 445 Conduct Phase 1 clinical trial of microencapsulated ETEC CS6 vaccine to confirm its safety and immunogenicity. Perform preclinical evaluation and general safety of ETEC CS6 vaccine. Produce second lot of microencapsulated ETEC CS6 vaccine under GMP conditions.
- 437 Assess protection by candidate live-attenuated or carrier-based Campylobacter vaccines against homologous and heterologous challenge in animal models. Scale up production of a live-attenuated or carrier-based Campylobacter vaccine under GMP conditions.
- 136 Complete field testing of malaria and Shigella diagnostic tests. Field test multiple specimen collection and processing systems to support development of a portable system for far-forward diagnosis of infectious diseases.
- 670 Evaluate sensitivity and specificity of a rapid dengue antibody test for clinical use in future vaccine field trials.
- 51 Complete assessment of effectiveness of an antiviral drug (ribavirin) against sandfly fever virus in humans. Provide data to the FDA for this new indication for ribavirin use.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology
	PROJECT D810

FY 1999 Planned Program: (continued)

- 72 Conduct safety and immunogenicity testing of candidate hepatitis E vaccine in humans. Determine infection and disease rates in selected field site for future evaluation of candidate hepatitis E virus vaccines.
- 96 Assess significance of rickettsial infection as a threat to deployed warfighters. Evaluate scrub typhus rapid diagnostic device.
- 251 Conduct Phase 1 studies of three candidate vaccine formulations for prevention of bacterial meningitis due to Group B *Neisseria meningitidis*.
- 215 Demonstrate the effectiveness of Global Information Systems (GIS) in mapping, monitoring and predicting risk of vector-borne disease transmission. Field test device to detect any combination of dengue, *P. falciparum* and *P. vivax* in mosquitoes. Field test ELISA for identification of *Leishmania donovoni* in sand flies. Evaluate a prototype expert system for rapid assessment of vector borne diseases at the Army Medical Department (AMEDD) Center and School.
- 905 Produce, purify and bottle 15-20 new vaccines at the vaccine pilot production facility under GMP conditions, applying the new technologies tested in FY98 research efforts. Conduct clinical trials of 10-15 vaccine candidates in volunteer recipients at the Clinical Trials Department of WRAIR.
- 52 Evaluate safety of a hantavirus vaccine in humans.

177 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 8480

FY 2000 Planned Program:

- 1727 Analyze clinical samples from vaccine trials for specific humoral and cellular immune responses to component antigens. Produce *P. falciparum* sporozoites, and research grade recombinant antigens and synthetic peptides. Conduct preclinical studies of candidate vaccines to support sections 7 (Chemistry, Manufacturing and Control) and 8 (Pharmacology and Toxicology) of an IND application. Develop a method to perform CONUS-based *P. vivax* sporozoite challenge.
- 2958 Maintain a drug repository to include acquisition, storage and distribution. Prepare gram and kilogram quantities of drug candidates under Good Laboratory Practice (GLP)/GMP. Perform pharmacokinetics, absorption, disposition, biotransformation and excretion studies of new drugs. Perform preclinical toxicology studies of new drugs. Perform quantitative analysis of drugs in biological fluids. Prepare drug delivery systems of compounds under GLP/GMP. Conduct a surveillance program for drug-sensitivity patterns of malaria from diverse geographic regions. Prepare Good Clinical Practice (GCP)-capable test sites for advanced testing of drug candidates.
- 429 Evaluate immune responses generated by candidate *Shigella* vaccines. Develop, manufacture, and evaluate subcellular candidate vaccines. Develop and evaluate rapid and economical diagnostic techniques for use in *Shigella* vaccine trials. Conduct epidemiological evaluation of potential *Shigella* vaccine field trial sites.
- 430 Characterize parameters of ETEC protection in humans. Conduct proof-of-concept testing of a microencapsulated, adherence factor-based vaccine in a human challenge model (6.2 and 6.3). Conduct proof-of-concept testing of a killed whole cell/recombinant B subunit vaccine in a human challenge model. Conduct in vitro and in vivo studies of mucosal adjuvants. Identify and develop field sites for testing ETEC vaccine candidates.
- 510 Elucidate the components of a protective immune response in the human challenge model and in natural infection. Study the relative roles of cellular, humoral, and mucosal immunity in recovery from acute *C. jejuni* disease and in long-term protective immunity. Study the antigen-specific immune

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology
	PROJECT D810

FY 2000 Planned Program: (continued)

responses to known and newly characterized antigens (e.g., rFla, PEB, CDT). Compare the immune response to natural infection with the characteristics of the immune response generated in persons given adjuvanted whole-cell vaccine and with the immune responses in immunized or infected animals that are protected against illness. Study the antigen-specific nature and persistence of the immune responses over longer periods of time after infection and its relationship to protection. Evaluate circulating and mucosal antibodies as well as markers of T-cell mediated immunity, including T-cell memory.

- 189 Optimize unique gene amplification primers and probes. Identify multiple gene targets per agent. Develop field test sites and collect well-characterized clinical specimen collections.
- 604 Prepare for/execute Phase 1 tests of "dead" and DNA vaccine candidates that retain potential for rapid (i.e., suitable for travelers) immunization. Refine human challenge model as tool for development of dengue vaccines. Conduct additional studies of WRAIR and PMC tetravalent live vaccines to assess their commercial potential. Characterize natural immune responses to dengue viruses that protect against severe disease upon heterologous challenge. Characterize vector role in determining outcome (no infection, infection, disease) and whether human challenge model is valid only when virus is inoculated by mosquito bite. Train cadre for vaccine studies CONUS and OCONUS. Identify sites/populations for Phase 1b evaluation of vaccine candidates among adults with well-characterized immunity to one or two dengue viruses, or yellow fever vaccine, or Japanese encephalitis (JE) vaccine.
- 55 Investigate disease outbreaks to validate assays and obtain fresh field samples for viral isolation and antibody analysis. Develop testbeds for efficacy evaluations of candidate vaccines and protective strategies in human, at-risk populations.
- 284 Perform family studies to assess importance of reinfection (infection with anamnestic antibody response), waning antibody levels in older adults, and the relevance of these phenomena to disease. Prepare for Phase 3 vaccine study in Nepal and to support Phase 2 vaccine studies elsewhere in Asia and Africa. Characterize determinants and pathophysiology of fulminant hepatitis E. Initiate Phase 1 study of combined hepatitis E and hepatitis A vaccine. Train cadre for vaccine studies in Nepal; maintain expertise in tropical hepatology.
- 110 Prepare one or more potential vaccines candidates (e.g., recombinant, DNA) and evaluate their protective efficacy in mice against homologous challenge. If homologous efficacy is established, then evaluate the vaccines' efficacy against heterologous challenge.
- 264 Produce preclinical lots vaccines using the three approaches: (1) native outer membrane vesicles (NOMV) presented as an intranasal vaccine; (2) purified OMP and LOS recombined as noncovalent complexes, in liposomes or as proteoliposomes presented as a parenteral vaccine; and (3) NOMV from an *htrB(-)* mutant that expresses a low toxicity LOS presented as a parenteral vaccine. Prepare and characterize cGMP lots of vaccine and conduct preclinical testing of the vaccines in animals. Prepare and submit clinical protocols and IND applications for FDA approval. Define more completely the optimal conditions or methods for production of the OMP-dLOS and/or NOMV vaccines to ensure reproducibility and optimal immunogenicity. Prepare a cGMP grade lot of vaccine using one of the new vaccine strains.
- 297 Conduct risk assessment and identification of vectors. Evaluate the threat of tick and chigger-borne diseases to the U.S. military. Seek and test new repellent candidates that will outperform the current repellent (DEET) in durability, effectiveness, and user acceptability. Coordinate fielding of improved bednet by entering into the appropriate development process that will fund final testing for efficacy. Begin development of a dengue Vector Control System, an integrated system of tools and information that can be physically packaged for a Preventive Medicine Detachment (or service

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology
	PROJECT D810

FY 2000 Planned Program: (continued)

equivalent): (1) Begin evaluation of existing devices for evaluating biting rate of these vectors; (2) begin development of handbook and accompanying software for identification of vectors, evaluation of pathogens in humans and vectors, and most appropriate control and surveillance techniques; and (3) establish requirements document and liaison with those who field equipment to MTOE units.

- 21 Devise processes for manufacture of at least 10 new vaccine lots under cGMP compliance.
- 54 Improve capability to rapidly identify, assess risk, and formulate control strategies for hantaviruses, including conduct of serosurveys of rodents or humans to detect hantaviruses. Publish a detailed assessment of the threat of hantaviruses to military operations.

Total 7932

FY 2001 Planned Program:

- 1816 Conduct preclinical studies of a *P. vivax* vaccine. Validate the *P. vivax* experimental challenge model.
- 3446 Transition to advanced development at least one new drug for oral treatment of multidrug-resistant malaria. Complete evaluation of prototype kits and other methodologies for determining with greater than 90% accuracy the degree of malaria parasites' resistance to therapeutic agents in both focal and broadly endemic geographic regions. Submit IND to the FDA for a drug that will effect radical cure of malaria.
- 433 Transition to advanced development a *S. dysenteriae* candidate vaccine with potential to protect 80% of immunized personnel.
- 434 Transition to advanced development an oral microencapsulated ETEC vaccine with potential to protect 80% of immunized personnel from traveler's diarrhea.
- 510 Conduct animal studies to determine safety and immunogenicity of combined enteric (Campylobacter, Shigella and ETEC) vaccine formulations.
- 181 Evaluate the nucleic acid analysis system platform to confirm broad application to multiple agents and sample sources. Integrate the reporting system into the nucleic acid system platform.
- 621 Transition to advanced development a candidate polyvalent dengue virus vaccine with potential to protect 80 percent of immunized personnel from dengue fever caused by dengue virus types 1, 2, 3, and 4.
- 351 Provide strategy for countering all viral hepatitis threats worldwide.
- 54 Transition to advanced development a monovalent group B Meningococcal vaccine with the potential of reducing disease by over 70 percent in immunized personnel. Conduct Phase 1 studies of multivalent vaccine candidates for prevention of bacterial meningitis due to group B *Neisseria meningitidis.*
- 250 Transition to advanced development insect repellent to replace DEET.

Total 8096

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D815

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D815 National Medical Testbed	7495	7947	0	0	0	0	0	0	0	15442

Mission Description and Justification: By Congressional direction, the purpose of this project is to develop initial research models for national medical testbed which display measurable improvements in cost and effectiveness in many areas of health care delivery.

FY 1998 Accomplishments:

- 7495 Awarded contract to Loma Linda Medical Center - National Medical Testbed.

Total 7495

FY 1999 Planned Program:

- 7736 Support studies that will benefit civilian and military personnel with diagnostic and therapueutic modalities. Fields of interest include management of trauma and shock; chronic disorders; prevention of premature delivery and brain injury at birth; modalities that may improve the rate of tissue and bone healing as well as the regulation of growth, healing, and bone restructuring; prevention of hypoxic brain injury at birth and brain injury; and development and testing of new medical instrumentation.
- 211 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 7947

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D818

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D818 Advanced Cancer Detection Center	3270	0	0	0	0	0	0	0	0	3270

Mission Description and Justification: By Congressional direction, the purpose of this project is to develop research models for an advanced cancer detection center for military personnel, dependents, and retired servicemembers, using a network including a military hospital or hospitals, a regional TRICARE provider, a Department of Veteran Affairs hospital or hospitals, and a medical facility with a focused cancer center, in order to conduct coordinated screening for early detection and treatment to train military cancer specialists, and to develop improved cancer detection equipment and technology.

FY 1998 Accomplishments:

- 3270 Army assumed management of the ongoing Navy research program, including evaluation of the project, and provision of supplemental funding to the University of South Florida Advanced Cancer Detection Center.

Total 3270

FY 1999 Planned Program: Project not funded under this PE in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D819

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D819 Field Medical Protection and Human Performance Enhancement Non-Systems - Advanced Development	0	0	200	194	557	576	618	647	Continuing	Continuing

Mission Description and Justification: This project supports laboratory validation studies and field demonstrations focused on soldier protection, sustainment, and enhancement associated with soldiers operating, wearing, and consuming materiel systems in all climatic and operational conditions. Specific support includes medical development of laser eye protection technologies and laser bioeffects treatment, environmental health monitoring methods to link soldier physiological status with climatic and environmental conditions, methods to enhance sleep and alertness during continuous/sustained operational scenarios, nutritional strategies to enhance soldier mental and physiological performance, and medical protection from vibration and repeated shock hazards arising from the operation of combat vehicle and aircraft systems and rapid test kits for toxic industrial and agricultural chemicals.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program:

- 200 Develop a rapid detection system for toxic industrial and agricultural chemicals that present acute neurotoxic risks (mediated through oxidant stress mechanisms) to deployed soldiers.

Total 200

FY 2001 Planned Program:

- 194 Continue development of rapid detection system.

Total 194

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D840

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D840 Combat Injury Management	3252	2450	2407	2435	2662	5234	6122	6562	Continuing	Continuing

Mission Description and Justification: This project funds prototypes of nonsystem-specific medical materiel items for far-forward medical management of shock and trauma and for casualty resuscitation including preclinical testing of large standard lots of candidate compounds and equipment to obtain data necessary for Food and Drug Administration (FDA) approval for human use. A major contractor is the University of North Carolina, Chapel Hill, NC.

FY 1998 Accomplishments:

- 512 Transitioned Advanced Surgical Suite for Trauma Casualties (ASSTC) to advanced development.
- 300 Developed breadboard prototype for all-electric dental field operating system.
- 185 Completed laboratory validation of far-forward version of a microwave resuscitation fluid warmer.
- 277 Tested landmine protective footware in cadaver models.
- 254 Established models for studies into blood loss and resuscitation.
- 250 Tested receptor activating/blocking compounds in animal models to assess neuroprotective efficacy.
- 400 Conducted preclinical studies to evaluate fibrin-based hemostatic bandage formulation for hemorrhage.
- 202 Began to assess efficacy of fibrin foam as hemostatic agent in preclinical models of organ trauma.
- 200 Began clinical testing of a frozen red blood cell washer.
- 300 Began clinical testing of a 10-week red blood cell storage solution.
- 172 Completed development of a digital dental radiographic imager to remove requirements for field film and film development equipment.
- 200 Submitted Critical Care System for Trauma and Transport (CSTAT) for airworthiness certification.

Total 3252

FY 1999 Planned Program:

- 50 Continue tests of microwave warming catheter in treating hypothermia.
- 225 Explore diagnostic imaging technologies for use in far-forward environments.
- 266 Evaluate treatments for wound repair (e.g., freeze-dried allografts, skin preparations).
- 100 Refine field-deployable all-electric dental operating system.
- 200 Perform research into infectious organisms' role in periodontal disease and other dental infections.
- 600 Continue testing neuroprotective drugs in animal models to assess efficacy.
- 300 Continue clinical testing of 10-week red blood cell storage solution to assess safety and efficacy.
- 100 Complete clinical testing of frozen red blood cell washer.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology
	PROJECT D840

FY 1999 Planned Program: (continued)

•	200	Evaluate formulations for extended liquid storage of platelets to enhance availability in far-forward locations.
•	350	Continue evaluation of fibrin foam in preclinical models of organ trauma.
•	59	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	2450	

FY 2000 Planned Program:

•	50	Complete tests of microwave warming catheter to treat hypothermia.
•	200	Continue to explore diagnostic imaging technologies for use in far-forward environments.
•	300	Continue to evaluate treatments for wound repair (e.g., freeze-dried allografts, skin preparations).
•	100	Complete development of a field-deployable all-electric dental operating system.
•	200	Investigate microencapsulated anti-inflammatory pulp-capping agents to enhance return to duty in far-forward locations.
•	600	Continue testing neuroprotective drugs in animal models to assess efficacy.
•	300	Complete clinical testing of 10-week red blood cell storage solution.
•	400	Continue evaluation of fibrin foam in preclinical models of organ trauma.
•	257	Test lead formulation for extended liquid storage of platelets in appropriate animal model.
Total	2407	

FY 2001 Planned Program:

•	500	Test commercial off-the-shelf oxygen carrier solutions in austere environments to assess suitability for military use.
•	300	Develop advanced field dressing incorporating ease of use, air tight seal, and advanced materials.
•	800	Develop and test miniaturized field oxygen concentrators to replace bottled oxygen.
•	200	Transition 10-week red blood cell storage solution to advanced development.
•	235	Transition fibrin foam to Phase 1 clinical trials.
•	200	Begin preclinical trials of antisense DNA as a therapy against excess mucus secretion after smoke inhalation.
•	200	Transition formulation for extended liquid storage of platelets to advanced development.
Total	2435	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D922

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D922 Emergency Telemedicine	2343	0	0	0	0	0	0	0	0	2343

Mission Description and Justification: By Congressional direction, this program supports efforts to develop, facilitate, and improve the application of telemedicine technologies. This program develops engineering applications specific to emergency medicine including trauma, medical imaging, lab outreach and patient tracking.

FY 1998 Accomplishments:

- 2343 Contracted with Mercy Health Care System to provide research related to diagnosis and treatment-based interventions through the application of telemedical and telecommunication-based technologies in order to improve medical outcomes. Findings from this research project will address accuracy of diagnosis; rapid initiation of treatment; and assist emergency medical specialists and rescue teams to more effectively address the needs of patients who are located in remote locations.

Total 2343

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D923

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D923 Prostate Diagnostic Imaging	4683	7450	0	0	0	0	0	0	0	12133

Mission Description and Justification: By Congressional direction, the purpose of this project is to develop initial research models for prostate cancer research to include studying prostate cancer diagnosis and treatment. The Army established a public/private research project with appropriate government agencies and private institutions to explore promising technologies for improvement of prostate diagnostic imaging and treatment technology.

FY 1998 Accomplishments:

- 4683 Awarded contract to the Henry Jackson Foundation (which will co-manage this effort with Walter Reed Medical Center). Efforts will include developing an advanced electronic, thin-film x-ray imaging technology for improved diagnostic location of prostate cancer using implanted radio opaque seeds, and advance the application of an ultrasound scanning system used in the Transrectal sensor system. Improvements will be retrofitted to prototype I for early evaluation. Such enhancements in the Transrectal sensor system will be included in Prototype II as appropriate.

Total 4683

FY 1999 Planned Program:

- 7253 Continue intramural research effort conducted by the Walter Reed Center for Prostate Disease Research in the area of prostate cancer detection and treatment.
- 197 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 7450

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D924

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D924 Advanced Trauma Care	2810	0	0	0	0	0	0	0	0	2810

Mission Description and Justification: By Congressional direction, this program funds the development of technology to promote real-time medical situational awareness through medical mentoring and consultation.

FY 1998 Accomplishments:

- 2810 Awarded contract to Illinois Institute of Technology Research Institute (IITRI).
  Efforts will include:
  Research in telecommunications, medical informatics, and analog-to-digital conversion technologies for support of advanced trauma care.
  Support Department of Defense government-wide strategy to implement emergency medical response via a national telemedicine network.

Total 2810

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D929

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D929 Artificial Lung Technology	1405	845	0	0	0	0	0	0	0	2250

Mission Description and Justification: By Congressional direction, the purpose of this program is to develop an intravenous membrane-based oxygenator to enable oxygen delivery to patients with pulmonary insufficiency.

FY 1998 Accomplishments:

- 1405 Solicited and evaluated proposals and made an award.

Total 1405

FY 1999 Planned Program:

- 823 Complete initial acute and long-term (21 days) testing of intravenous membrane oxygenator patency and function in an animal model of pulmonary insufficiency.
- 22 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 845

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D930

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D930 Cooperative Teleradiology	2810	0	0	0	0	0	0	0	0	2810

Mission Description and Justification: By Congressional direction, this program funds the development of experimental technologies that will allow medical imaging to be deployed in remote and far-forward locations. Additionally, this program funds the research for the development of imaging networks that can deliver medical studies for interpretation.

FY 1998 Accomplishments:

- 2810 Awarded contract to University of South Florida (USF). This is a cooperative research effort between the Uniformed Services University of the Health Sciences (USUHS) and the USF.

Total 2810

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D932

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D932 Periscopic Minimally Invasive Surgery	16000	0	0	0	0	0	0	0	0	16000

Mission Description and Justification: By Congressional direction, this project funds research and development in minimally invasive back and spine surgery methods, protocol, and technologies to improve processes and outcomes.

FY 1998 Accomplishments:

- 3000 Contract awarded to Georgetown Medical Center as a cooperative agreement to conduct research and development in Periscopic Minimally Invasive Surgery to improve protocols and outcomes of back/spine surgery.
- 13000 Developed a program at Massachusettes General Hospital/Harvard University that will conduct collaborative research between industry, medical research institutions and DOD health care and research organizations to develop and evaluate new techniques utilizing non-invasinve and minimally invasive diagnostic and surgical techniques

Total 16000

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D933

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D933 Proton Beam Therapy	4000	0	0	0	0	0	0	0	0	4000

Mission Description and Justification: By Congressional direction, this project funds proton radiation therapy technology. Proton radiation therapy improves physicians' ability to treat cancer and some benign disorders with radiation; it responds to the need for improved control of beam delivery, enabling physicians to increase the likelihood of disease control while reducing treatment side effects.

FY 1998 Accomplishments:

- 4000 Received research proposal. Contract awarded to Loma Linda to conduct research and development in proton radiation therapy, and the need for improved control of beam delivery.

Total 4000

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D934

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D934 Volume Angiocat	3747	3974	0	0	0	0	0	0	0	7721

Mission Description and Justification: By Congressional direction, this project will fund development of a multimodality platform integrated into a single device that will perform many aspects of diagnostic studies.

FY 1998 Accomplishments:

•	3747	Awarded contract to MultiDimensional Imaging (MDI), Inc.
Total	3747	

FY 1999 Planned Program:

•	850	Develop sequential rapid slice or high speed computer tomography (HSCT) scanning to provide true real-time and true volume 4D imaging.
•	750	Develop state-of-the-art CT spatial resolution, superior tissue contrast resolution, and improved signal-to-noise ratio with a photon flux rate 10X that of electron beam computer tomography (EBCT) or HSCT.
•	650	Provide markedly superior temporal resolution with routine exposure times of 50-100 ms compared to about 1 sec in current state-of-the-art HSCT A.
•	619	Create a single rapid diagnostic examination that will replace 2-4 examinations that are currently being performed.
•	500	Integrate stereo fluorography and high resolution digital radiography into the 3D/4D volume imaging for combined digital angiography, mammography, or 3D fluoroscopic guidance of instrumentation.
•	500	Allow for routine body scanning at 1.0-3.0 mm slice thickness interpolated down to 0.1mm and will scan at speeds over 100X the current EBCT or 400X that of spiral scanning technologies, in a given volume.
•	105	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	3974	

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D937

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D937 Nervous System Studies	4468	0	0	0	0	0	0	0	0	4468

Mission Description and Justification: By Congressional direction, the purpose of this effort is to support continuing research programs related to the mechanisms and treatment of central nervous system injury (brain trauma, spinal cord injury, and/or stroke) and related cognitive dysfunction.

FY 1998 Accomplishments:

- 4468 Received research proposal. Scientifically review full proposal; award contract (to be accomplished in FY1999).

Total 4468

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D938

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D938 Tissue Engineering	3500	0	0	0	0	0	0	0	0	3500

Mission Description and Justification: By Congressional direction, this project supports the development of tissue substitutes using biologic molecules deposited with a laser fusion technique. These tissues and methods lend themselves to far forward use on the battlefield and will serve to reduce the mortality and disability of severe trauma.

FY 1998 Accomplishments:

- 3500 Phase 3 proposal received and reviewed. Contract award to be completed in FY1999.

Total 3500

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D939

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D939 Medical Imaging	3500	0	0	0	0	0	0	0	0	3500

Mission Description and Justification: By Congressional direction, the purpose of this project is to conduct research and development efforts in three-dimensional medical imaging (e.g., ultrasound).

FY 1998 Accomplishments:

- 3500 Contracted with Cleveland Clinic to perform research and development in medical imaging.

Total 3500

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D940

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D940 Epidermolysis Bullosa	1000	0	0	0	0	0	0	0	0	1000

Mission Description and Justification: By Congressional direction, the purpose of this project is to investigate the pathophysiological similarities of sulfur mustard (SM) injuries to the naturally occurring disease Epidermolysis Bullosa (EB).

FY 1998 Accomplishments:

- 1000 Received research proposals. (Award contract in FY1999.)

Total 1000

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D941

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D941 Diabetes Research	4000	4470	0	0	0	0	0	0	0	8470

Mission Description and Justification: By Congressional direction, the purpose of this project is to conduct diabetes research.

FY 1998 Accomplishments:

- 2859 Contract awarded to Joslin Diabetes Center for research in improving methods of detection, prevention, and diagnosis of diabetes.
- 570 Contract awarded to the Department of Veterans Affairs to assist in research in improving methods of detection, prevention, and diagnosis of diabetes.
- 571 Contract awarded to Tripler Army Medical Center to assist in research in improving methods of detection, prevention, and diagnosis of diabetes.

Total 4000

FY 1999 Planned Program:

- 3900 Continue FY 1998 program (digital capture of retinal images to detect, prevent, and diagnose Type II diabetes).
- 451 Begin implementation of Phase 2 of program.
- 119 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 4470

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D954

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D954 Digital X-Ray	0	3973	0	0	0	0	0	0	0	3973

Mission Description and Justification: By Congressional direction, this program funds development of a prototype portable digital x-ray for field and fixed facility applications.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

- 3868 Develop, at the General Electric Center for Research and Development, prototype portable digital x-ray for field and fixed facility applications.
- 105 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3973

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

PROJECT: D955

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D955 Assistive Technology	0	5960	0	0	0	0	0	0	0	5960

Mission Description and Justification: By Congressional direction, this program funds the research, development, and evaluation of technologies (initially developed for military and space purposes) that can be used to improve the lives of Americans with disabilities.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

- 5802 Research, develop, and evaluate, at the National Rehabilitation Hospital Assistive Technology Center, technologies initially developed for military and space purposes that can be used to improve the lives of Americans with disabilities.
- 158 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 5960

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

COST (*In Thousands*)		FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	85778	44834	34167	38585	44792	49364	80896	83890	Continuing	Continuing
D313	Advanced Rotary Wing Vehicle Technology	5127	16998	23634	23742	28169	31301	61773	52651	Continuing	Continuing
D391	D391	907	953	0	0	0	0	0	0	0	7682
D435	Aircraft Weapons	0	0	1438	4282	4648	5439	5855	11681	Continuing	Continuing
D436	Rotary-Wing Mission Equipment Package Integration	17199	5063	2103	3621	5131	5805	6165	12122	Continuing	Continuing
D447	Aircraft Demonstration Engines	5964	6584	6992	6940	6844	6819	7103	7436	Continuing	Continuing
D448	Stinger Universal Launcher	10867	0	0	0	0	0	0	0	0	11242
D464	Outrider Unmanned Aerial Vehicle	42156	0	0	0	0	0	0	0	0	42156
DA38	Starstreak	3185	15000	0	0	0	0	0	0	0	18185
DB97	Aircraft Avionics Equipment	373	236	0	0	0	0	0	0	0	1086

A. Mission Description and Justification: The objective of this program element (PE) is to conduct advanced technology development, integration, demonstration and transition of rotary wing vehicle (RWV) technologies to new and / or upgraded DoD / Army rotorcraft systems in support of Joint Vision 2010 and Army After-Next. RWVs offer practical solutions to many of the DoD / Army's current and future operational needs by their ability to accomplish tasks and missions which no other air or ground vehicle can perform (e.g., takeoff and land vertically, operate at or below tree-top level for Nap-of-the-Earth (NOE) missions). RWV configurations require significantly different analysis, integration and design challenges from traditional fixed wing vehicles that fly at higher altitudes. The Army Aviation Science and Technology program's functional organization, supported by the National Aeronautics and Space Administration (NASA) at three co-located activities, is the focal point for US efforts in rotorcraft technology. Technology areas for development / demonstration include aeromechanics, aerodynamics, structures, propulsion, reliability and maintainability, safety and survivability, mission support equipment integration, aircraft subsystems, advanced helicopter rotors and flight controls, flight simulation, aircrew-aircraft system integration, aircraft weapons integration for air-to-air / air-to-ground, aircraft avionics for command and control, communications, controls and displays, digital avionics and architectures, NOE navigation, mission planning, and air traffic management. These technologies are continuously being demonstrated for

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603003A Aviation Advanced Technology

applications that will improve and correct deficiencies in current DoD / Army RWV systems, and to improve the capabilities of future rotorcraft. The PE focuses on demonstrating

technologies to enable rotorcraft to operate affordably throughout the military spectrum from peacekeeping to combat missions. The work in this PE is consistent with the DoD Technology Area Plans, DoD Warfighting Science and Technology Master Plan, DoD Reliance Agreements (for which the Army is the lead service for the rotorcraft technology development) the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and a coordinated government/industry/academia national RWV Technology Development Approach. Technology demonstrated in this PE will support the future DoD Joint Transport Rotorcraft (JTR) identified to potentially replace the aging Army CH47D Chinook and Navy CH-53 Super Stallion helicopters. Upgrade activities [as applicable] of Army systems such as the AH-64 Apache, RAH-66 Comanche, UH-60 Blackhawk, Navy SH-60 Seahawk and USMC AH-1 Cobra are supported as well.

Work in this PE is performed by contractors including Georgia Institute of Technology, Atlanta, GA; Boeing Company, Mesa, AZ; and Philadelphia, PA; Loral Western Development Laboratories, San Jose, CA; Bell Helicopter Textron Incorporated, Ft. Worth, TX; Lockheed Martin, Atlanta, GA; General Electric, Lynn, MA; Allied Signal Engines, Phoenix, AZ; Honeywell, Minneapolis, MN; Sikorsky Aircraft, Stratford, CT; BDM International, Albuquerque, NM; MITRE, McLean, VA; Shorts Missile Systems, Belfast Northern Ireland, and CAE Electronics, Montreal, Canada.

Primary in-house developers of the technology under this program element include: Aviation and Missile Command (AMCOM), Redstone Arsenal, AL., Aeroflightdynamics Directorate, AMCOM, NASA Ames Research Center, Moffett Field, CA; Aviation Applied Technology Directorate, AMCOM, Ft. Eustis, VA; Vehicle Technology Center, Army Research Laboratory (ARL), NASA Langley Research Center, Hampton, VA; and Vehicle Technology Center, ARL, NASA Lewis Research Center, Cleveland, OH. Related activities are performed by National Aeronautics and Space Administration.

This program adheres to DoD Reliance Agreements on Aeropropulsion and Air Vehicles (Rotary Wing). Related applied research is conducted under PE 0602211A (Aviation Technology). Efforts under this PE transition and provide risk reduction for and lead into Demonstration / Validation and Engineering Development programs supported by PE 0603801A (Aviation - Advanced Development), PE 0604801A (Aviation - Engineering Development) and PE 0604270A (Electronic Warfare Development). In addition, this PE's deliverables provide technical support and technology transition to PE 0604223A (RAH-66 Comanche), PE 0604816A (Longbow), and PE 0203744A (Aircraft Modifications/Product Improvement).

The Army participates in and with the following groups, organizations and programs for total coordination: the DoD Tri-Service Joint Technical Coordination Group for Munitions Development and Aircraft Survivability; Aircraft Instruments and Aircrew Station Working Group; the Joint Integrated Avionics Working Group (JIAWG); Integrated High Performance Turbine Engine Technology (IHPTET) Steering Committee; and the Air Armament Working Party of NATO. This participation enables the gathering of technical information and assets in determining the joint use and standardization of airborne weaponization items. The Army Munitions Research and Development Committee, an organization within the Office of the Secretary of Defense, functions to establish Joint Service requirements and the development of air munitions. International related activities are The Technical Cooperation Programs (TTCP) with Australian, Canadian and United Kingdom governments, and Defense Development Share Plans. Formal Memoranda of Understanding (MOUs) and Data Exchange Agreements (DEAs) with various friendly nations are actively pursued to allow technology information exchange.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	89467	30048	36197	39742
Appropriated Value	92330	45048		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-2863	-214		
b. SBIR / STTR	-2244			
c. Omnibus or Other Above Threshold Reductions	-745			
d. Below Threshold Reprogramming	-700			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-2030	-1157
Current Budget Submit (FY 2000/2001 PB)	85778	44834	34167	38585

Change Summary Explanation: Funding – FY 1999 – Congressional add for Starstreak (+15000).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D313

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D313 Advanced Rotary Wing Vehicle Technology	5127	16998	23634	23742	28169	31301	61773	52651	Continuing	Continuing

Mission Description and Justification: This project provides for RWV technology demonstrations in support of research for advanced rotors / controls, flight controls, airframes/structures, crew/vehicle survivability, drive-trains and subsystems to increase strategic/tactical mobility, increase maneuverability / agility; increase reliability through improved maintainability/sustainability, and reduce acquisition and operational cost. Technology Demonstrations funded by this project include Rotary Wing Structures Technology (RWST), Advanced Rotorcraft Transmission Phase II (ART-II), Helicopter Active Control Technology (HACT), Variable Geometry Advanced Rotor Demonstration (VGARD), Survivable, Affordable, Repairable Airframe Program (SARAP), Rotorcraft Drive Systems for the 21st Century (RDS21), and Full Spectrum Threat Protection (FSTP). These programs will focus on the demonstration and transition of advanced technology to the Joint Transport Rotorcraft (JTR) program to meet the cargo / transport and commuter needs of the military and civilian sectors, as well as technology insertion for other DOD legacy rotorcraft systems. Funding profile supports these technology demonstrations which have been approved in DOD modernization plans for rotorcraft. These plans include the development of the future DoD JTR, identified to potentially replace the aging Army CH-47D Chinook and Navy CH-53 Super Stallion helicopters.

FY 1998 Accomplishments:

- 1085 - Conducted preliminary design of structural concepts to satisfy structural integrity requirements that will reduce manufacturing labor costs and structural airframe weight.
- 3577 - Conducted testing on positive engagement overrunning clutch for advanced transmission initial performance assessment.
  - Completed advanced transmission detailed design that when demonstrated will provide a –10 dB noise reduction, 25 % increase in power-to-weight, and 2X increase of transmission durability.
  - Began fabrication of complex, long lead advanced transmission demonstrator parts including precision forged planetary gears, ceramic / composite hybrid spherical roller bearings, large high temperature / corrosion resistant magnesium alloy housing, and forging for large double helical gears.
- 465 - Defined, with Industry and other Services, the helicopter active controls program to develop and flight demonstrate an affordable, advanced rotorcraft flight control system integrated with selected mission subsystems to improve handling qualities and mission effectiveness in day, night, and adverse weather conditions.

Total 5127

FY 1999 Planned Program:

- 8457 - Complete component testing of advanced transmission positive engagement overrunning clutch.
  - Complete fabrication of advanced transmission demonstrator hardware.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603003A Aviation Advanced Technology
	PROJECT D313

FY 1999 Planned Program: (continued)

- Assemble advanced transmission demonstrator and conduct development testing consisting of fit and function, oil management, gear tooth and bearing pattern verification, split torque path load sharing assessment, 50 hour endurance run, and gear tooth scoring testing for initial performance and cost assessment.
- Complete fabrication of diamond-like carbon coated gears, ring gear isolation, low noise bevel pinion, advanced bearing materials, heat exchangers, and seal hardware for reduced weight and increased durability when applied to upgraded UH-60 Blackhawk and AH-64 Apache helicopter transmissions.

- 3267 - Develop baseline helicopter active flight control system designs; evaluate design methodologies; conduct engineering modeling, simulation, analysis, and evaluate candidate active control system designs.
- 4848 - Conduct detailed designs of structural concepts using virtual prototyping which will reduce developmental and manufacturing risk of demonstration fuselage assemblies and reduce detail design cycle time in half the normal time.
- 426 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 16998

FY 2000 Planned Program:

- 7000 - Conduct advanced transmission endurance testing for demonstration of 25 % increase in power-to-weight and 2X increase in transmission durability.
  - Conduct advanced transmission noise testing to demonstrate a -10dB reduction in transmission noise.
  - Perform endurance testing of diamond-like carbon coated gears, ring gear isolation, low noise bevel pinion, advanced bearing materials, heat exchangers, and seal hardware for reduced weight and increased durability when applied to upgraded UH-60 Blackhawk and AH-64 Apache helicopter transmissions.
- 9734 - Conduct detailed design of active flight control system for demonstration.
  - Develop active flight control engineering models, and piloted and hardware in-the-loop simulation to support flight demonstration.
  - Determine reduction in flight control design and development costs.
  - Integrate hardware and software into demonstration rotorcraft.
- 6326 - Fabricate rotary wing structural demonstrator fuselage sections comprised of advanced structural concepts demonstrating reduced weight and manufacturing cost, and conduct full scale-crash testing of demonstrator fuselage.
- 574 - Conduct testing and validation of techniques and tools for simulation-based acquisition approaches based on integration of models, simulations, and virtual prototyping for defining JTR concepts and upgrades of other DoD rotorcraft.
  - Conduct operational scenarios using constructive and virtual simulations based on JTR concepts and missions emerging from developing Joint Service needs and AAN.
  - Demonstrate simulation models which integrate the advanced technologies from transmission, active flight controls, turbine engine, rotors, airframes / structures and signature management programs for defining JTR configuration alternatives and upgrades of other DoD rotorcraft.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603003A Aviation Advanced Technology
	PROJECT D313

Total 23634

FY 2001 Planned Program:

- 6482 - Develop RDS21 preliminary design for 35% increase in power-to-weight, -15dB noise reduction, 2X increase in durability and 25% reduction in production cost.
- 8741 - Conduct flight control subsystems flight tests.
  - Refine helicopter active flight controls engineering models and simulation.
  - Complete helicopter active flight control system design.
  - Begin helicopter active flight control flight tests and demonstration to measure flight control system improvement.
- 5519 - Conduct full-scale static testing of rotary wing structural demonstrator fuselage sections demonstrating weight, cost and development cycle time reductions.
  - Conduct reparability demonstrations on fuselage sections.
- 3000 - Conduct preliminary design and analyses to demonstrate and evaluate configuration alternatives for low disk-loading Vertical Take-Off and Landing (VTOL) aircraft (e.g., helicopter, tilt rotor, tilt wing) for JTR.
  - Demonstrate JTR configuration alternatives in distributed interactive simulation environment to evaluate impact on warfighting capabilities.
  - Predict the magnitude of improvements which can be obtained in JTR mission effectiveness in areas such as payload / range, maximum cruise speed, deployability, fuel efficiency, maneuverability / agility, system acquisition costs, operations and support costs, accident rate, survivability, and reliability.
  - Provide technical rationale and prioritized list of JTR configuration alternatives for focusing future advanced technology demonstrations on specific VTOL configurations for JTR.

Total 23742

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D435

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D435 Aircraft Weapons	0	0	1438	4282	4648	5439	5855	11681	Continuing	Continuing

Mission Description and Justification: This project demonstrates rotorcraft weaponization technologies for air-to-ground and air-to-air application. Integration of advanced missiles (Air-to-Air / Air-to-Ground), rockets, guns, fire control and advanced target acquisition are evaluated and demonstrated on rotorcraft platforms to assure compatibility of the weapon system with the rotorcraft. Technology integration issues with on-board systems, vehicle flight characteristics and weapon system are investigated and evaluated. The project will integrate Low Cost Precision Kill (LCPK) rocket system using a 2.75 rocket with a laser seeker sensor and will evaluate other technologies for providing rotorcraft air combat enhancements, including a lightweight, electric turret for a 20% increase in air-to-air accuracy.

FY 1998 Accomplishments: Project not funded in FY 1998

FY 1999 Planned Program: Project not funded in FY 1999

FY 2000 Planned Program:

- 1438 - Conduct AH-64 Longbow Apache aircraft preliminary integration design for Low Cost Precision Kill (LCPK) guided rocket system .
  - Conduct AH-64 Longbow Apache aircraft preliminary integration of Multi-Role Aviation Weapon System (MRAWS) lightweight, electric turret.

Total 1438

FY 2001 Planned Program:

- 4282 - Complete LCPK aircraft integration design and fabricate flight hardware for Apache Longbow to support airborne evaluation of the LCPK guided rocket.
  - Continue platform integration design for the MRAWS lightweight turret to include man-machine interface, improved feed system design, and fire control upgrades for the improved 30 mm combat round.

Total 4282

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D436

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D436 Rotary-Wing Mission Equipment Package Integration	17199	5063	2103	3621	5131	5805	6165	12122	Continuing	Continuing

Mission Description and Justification: The objective of this project is to demonstrate man-machine integration and mission equipment technology to provide enhanced helicopter pilotage capability, improved crew workload distribution and improve overall mission execution. This is the primary project for the Rotorcraft Pilot's Associate (RPA) Advanced Technology Demonstration (ATD). It provides for the demonstration of rotorcraft crew stations utilizing knowledge-based information systems to develop Cognitive Decision Aiding (CDA) for crews. Advanced technology in information technology computing methods, sensors, displays, and controls will be demonstrated to maximize combat helicopter mission effectiveness and survivability for day / night adverse weather operations. The RPA program will demonstrate data fusion, battlefield assessment, route, reconnaissance, survivability and sensor planning, and cockpit information management, attack planning and crew intent estimation for dual crew operations. System Build 6 will complete and refine the RPA CDA software for use in the Combined Arms II simulation exercise and flight-test program. This demonstration of simulation capability will therefore be used as the foundation for evaluating combined rotorcraft control and crew performance via virtual prototyping and Distributed Interactive Simulation (DIS) and pursues state of the art technology for integration and linking a manned scout / attack rotorcraft with an unmanned aviation system to perform Army aviation missions. The Airborne Manned/Unmanned System Technology (AMUST) program integrates advanced technologies in sensors, displays, communication and controls necessary to team airborne manned and unmanned vehicle to maximize the teams' lethality, survivability, and operational tempo in support of the maneuver commander. The manned/unmanned team will be capable of performing scout and reconnaissance assignments and alerting manned rotorcraft of "just ahead" tactical situation awareness. The system will use state-of-the-art approaches in artificial intelligence, sensors, avionics, communications, pilot vehicle interfaces, and unmanned aerial vehicles, along with a level of autonomy that will result in an integrated team that augments the battlefield effectiveness of Army aviation.

FY 1998 Accomplishments:

- 16262 - Completed development of core architecture software; performed system build 6; integrated and tested Version 6 software; conducted performance demonstration, conducted preliminary engineering/integration flight testing; conducted operational evaluation flight testing; conducted government/industry system demonstrations.
  - Conducted engineering and full mission simulation System Formal Evaluations II in accordance with exit criteria.
  - Completed development of functional requirements for software builds.
  - Integrated classified data files; completed development of dual crew in the cockpit information management and improved the capacity of CDA with respect to team operations.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603003A Aviation Advanced Technology
	PROJECT D436

•	937	- Conducted trade-off analysis to define potential operational value and key technical issues related to manned and unmanned aerial vehicle scout teams. - Conducted virtual simulation of manned / unmanned aerial scout teams to identify critical operational functions and man-machine interfaces. - Conducted limited demonstration of connectivity between manned and unmanned aerial systems.
Total	17199	

FY 1999 Planned Program:

•	4980	- Conduct RPA flight test including operationally relevant scenarios and threats which will be subject to the same tactical environments used in the virtual simulations; perform data reduction, analysis, final report / briefing and transition technology and lessons learned to fielded / development systems. - Complete virtual simulation tests which serves as final effort to measure exit criteria.
•	83	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	5063	

FY 2000 Planned Program:

•	2103	- Define airborne manned / unmanned system technology configuration and interfaces of manned / unmanned aerial scouts teams. - Develop airborne manned / unmanned system technology algorithms to support critical operational functions. - Construct engineering simulation to support preliminary development and engineering evaluation of the system. - Conduct knowledge acquisition collection and refinement for scout / attack and Special Operations aviation forces' mission teams composed of manned and unmanned systems.
Total	2103	

FY 2001 Planned Program:

•	3621	- Complete preliminary hardware design and preliminary software system builds, and begin fabrication, modification, and integration activities for the AMUST test and evaluation - Develop and demonstrate AMUST Hardware in the Loop simulation - Conduct engineering simulation of the airborne manned / unmanned system technology system.
Total	3621	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D447

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D447 Aircraft Demonstration Engines	5964	6584	6992	6940	6844	6819	7103	7436	Continuing	Continuing

Mission Description and Justification: The objective of this project is to competitively perform design, fabrication and test of advanced technology engines and integrated components to demonstrate achievable improved performance levels for current and future DoD RWV emphasizing Army unique requirements. The current/planned 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 current fleet upgrades and for future new rotorcraft with significant Operation and Support cost savings.

FY 1998 Accomplishments:

- 5964 - Completed design and fabrication of gas generator II test and accessories.
  - Integrated gas generator II components that have advanced aerothermodynamic, mechanical, material and structural technologies into the first build of the gas generator.
  - Performed gas generator II test to provide a mechanical checkout of the gas generator and baseline performance demonstration.
  - Analyzed test data and optimized component designs for gas generator.
  - Developed gas generator III components draft detail design including metal matrix composite impellers, rich quench lean combustor with ceramic matrix composite liners, ceramic and ceramic matrix composite turbine airfoils, and magnetic bearings.

Total 5964

FY 1999 Planned Program:

- 6432 - Demonstrate JTAGG II goals of 80% increase in shaft horsepower to weight ratio, 30% decrease in specific fuel consumption and 20% reduction in acquisition and maintenance costs.
  - Complete gas generator III components detail design including dual-aluminide impellers, ceramic matrix composite combustor liners, ceramic and ceramic matrix composite turbine airfoils, and magnetic bearings for JTAGG III build.
  - Procure long-lead gas generator III hardware.
  - Conduct initial component testing in support of gas generator III initial build.
- 152 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 6584

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology — PROJECT: D447

FY 2000 Planned Program:

•	6992	- Fabricate / procure hardware for initial gas generator III build. - Continue initial component testing in support of initial gas generator III build. - Initiate gas generator III component design modifications in support of gas generator build.
Total	6992	

FY 2001 Planned Program:

•	6940	- Complete initial gas generator hardware fabrication and component testing - Conduct testing of JTAGG III initial gas generator build in support of 120% increase in shaft horsepower to weight, 40% decrease in specific fuel consumption, and 35% reduction in acquisition and maintenance costs. - Complete design modifications and fabricate / procure hardware for second gas generator build. - Conduct component testing in support of second gas generator build. - Perform JTAGG III component design modifications in support of final gas generator build for goal demonstration
Total	6940	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D448

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D448 Stinger Universal Launcher	10867	0	0	0	0	0	0	0	0	11242

Mission Description and Justification: This project supports a congressionally directed program to develop an Apache Longbow Stinger Universal Launcher (SUL). The SUL will be developed by FY99 with the highest degree of commonality between various host platforms.

FY 1998 Accomplishments:

- 10867 - Performed development of SUL / Stinger Universal Electronics (SUE) to support Apache, Comanche and Bradley Linebacker.
  - Developed Apache Longbow interface for the SUL / SUE and conducted integration testing.
  - Developed Comanche SUL interface.
  - Developed Bradley Linebacker SUE interfaces.

Total 10867

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D464

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D464 Outrider Unmanned Aerial Vehicle	42156	0	0	0	0	0	0	0	0	42156

Mission Description and Justification: The Tactical Unmanned Aerial Vehicle (TUAV), "Outrider", provides Army brigades/battalions, USMC regiments/battalions, and Navy forces with dedicated day/night, reconnaissance, surveillance and target acquisition (RSTA) and intelligence. Outrider provides the tactical warfighting commander with critical battlefield information in the rapid cycle time required for success at the tactical level. The Joint Requirements Oversight Council (JROC) reassessed warfighter UAV priorities and reconfirmed the TUAV as the JROC's top UAV priority to meet Service requirements. The Outrider Advanced Concept Technology Demonstration (ACTD) system consists of four air vehicles, each configured with an electro-optic (EO)/infrared (IR) sensor payload, ground control equipment, including communications equipment and launch and recovery equipment, remote video terminal, two HMMWVs and a trailer, and one mobile maintenance facility for every three TUAV systems. The ACTD contract has an option for six (6) LRIP systems. The Outrider LRIP options support a Full Rate Production (FRP) decision. The ACTD addressed Joint Services (Army, Navy, Marine Corps) tactical UAV requirements and validated military utility for each Service. The TUAV program employs "cost as an independent variable" in acquiring any follow-on systems. In FY99, this program transitions to PE 0305204A.

FY 1998 Accomplishments:

- 42156 - Completed 18 flights totaling 11 hours and 22 minutes of flight time.
  - Continued flight testing in support of Military Utility Assessment (MUA).
  - Completed system integration and demonstration.
  - Trained users for MUA.
  - Completed MUA (land & land / sea) and ACTD.
  - Evaluated MUA users lessons learned.
  - Prepared for transition from ACTD to Low Rate of Initial Production (i.e., documentation, air vehicle improvements, weight reduction).

Total 42156

FY 1999 Planned Program: Funded in PE 0305204A.

FY 2000 Planned Program: Funded in PE 0305204A.

FY 2001 Planned Program: Funded in PE 0305204A.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: DA38

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DA38 Starstreak	3185	15000	0	0	0	0	0	0	0	18185

Mission Description and Justification: This project supports a congressionally directed program to investigate air-to-air (ATA) applications of the Starstreak missile on rotary wing platforms. The effort explored the integration of the Air-to-Air Starstreak (ATASK) missile on the AH-64D Apache Longbow helicopter in preparation for a potential follow-on side-by-side comparison with the Air-to-Air Stinger (ATAS) missile. This effort follows a two-phased effort (FY95-FY97) in which the technical feasibility, safety and preliminary worth of the Starstreak (ATASK) was assessed as an air-to-air self defense weapon for the AH-64 Apache helicopter.

FY 1998 Accomplishments:

- 3185 - Designed roll stabilizing gimbal for Starstreak airborne laser guidance unit; designed Apache Longbow helicopter modifications to integrate Starstreak missile system into the aircraft based on Phase II data.

Total 3185

FY 1999 Planned Program:

- 6472 - Complete detail designs for roll stabilized airborne laser guidance unit to support Target Acquisition and Designation System (TADS) integration on Longbow Apache helicopter.
  - Complete detail designs for missile launcher blast diffuser, and hardware and electronic aircraft interfaces to support fabrication and build-up on Longbow Apache helicopter.
- 6250 - Fabricate & build roll stabilized laser guidance unit, missile launcher, and aircraft launcher & laser guidance unit interface components.
- 2278 - Integrate aircraft to launcher & guidance unit subsystems interface components into the Longbow Apache testbed to support bench & flight test programs.
  - Perform bench testing of subsystem components to preliminarily verify interface functionality of aircraft to subsystem components.

Total 15000

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE: February 1999
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology — PROJECT: DB97

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DB97 Aircraft Avionics Equipment	373	236	0	0	0	0	0	0	0	1086

Mission Description and Justification: This project supports development and demonstration of advanced, integrated avionics equipment in support of aviation integration into the digitized battlefield. Evolving concepts in digital avionics will provide new functional capability in the areas of situational awareness, flight path guidance, position reporting and digital data transfer. Work in this project supports the Rotorcraft Pilot's Associate (RPA) program.

FY 1998 Accomplishments:

- 373 - Provided RPA mission equipment integration support in the areas of communication, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence to support the instrumentation/calibration phase of the RPA flight test program.

Total 373

FY 1999 Planned Program:

- 230 - Complete RPA mission equipment integration support in the areas of communication, navigation, Advanced Helicopter Pilotage (AHP), voice recognition, controls and displays, and artificial intelligence, during the flight test program.
- 6 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 236

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603004A Weapons and Munitions Advanced Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	23694	24858	39893	38686	24288	30862	39214	51920	Continuing	Continuing
DL94 Electric Gun Systems Demonstration	0	0	0	0	0	2064	2517	14607	Continuing	Continuing
D43A Advanced Weaponry Technology Demonstration	7821	13345	25685	21982	11297	13612	20227	20575	Continuing	Continuing
D232 Advanced Munitions Demonstration	10252	11513	14208	16704	12991	15186	16470	16738	Continuing	Continuing
D233 Trajectory Correctable Munitions Development	5621	0	0	0	0	0	0	0	0	5621

A. Mission Description and Budget Item Justification: The objective of this Program Element (PE) is to demonstrate affordable, advanced weapons and munitions technologies that will increase battlefield lethality and survivability. Part of this PE funds several stand-off weapons demonstrations and sensors within the Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD), (field exercise in fourth quarter FY 1998 and extended user evaluation in FY 1999-2000), structured to significantly increase the capability of Early Entry Forces. The RFPI demonstrations funded within this PE include the Integrated Acoustic Sensor (IAS) and more responsive digitized fire control for a towed 155mm automated howitzer. An initiative in response to recent threat information, especially against new explosive reactive armors (which appear as appliqués), is the Direct Fire Lethality program, the purpose of which is to significantly enhance Abrams tank anti-armor lethality in terms of hit and kill by maximizing warhead/penetrator effectiveness and significantly increase tank gun accuracy under dynamic battlefield conditions. In the area of combat vehicle anti-armor munitions, advanced explosively formed penetrator warheads exploit technologies in explosives, liner materials and modeling, and demonstrate increased armor penetration through advanced warhead concepts. Work in this program element is consistent with Army Vision 2010, Army After Next, the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ. 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) and PE 0604802A (Weapons and Munitions – Engineering Development).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603004A Weapons and Munitions Advanced Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	25444	24555	42076	35558
Appropriated Value	26255	25055		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-811	-197		
b. SBIR / STTR	-602			
c. Omnibus or Other Above Threshold Reductions	-198			
d. Below Threshold Reprogramming	-950			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-2183	+3128
Current Budget Submit (FY 2000 / 2001 PB)	23694	24858	39893	38686

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603004A Weapons and Munitions Advanced Technology

PROJECT: D43A

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D43A Advanced Weaponry Technology Demonstration	7821	13345	25685	21982	11297	13612	20227	20575	Continuing	Continuing

Mission Description and Justification: This project includes the non-missile stand-off weapons and advanced concepts for the Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD), lethality enhancements under the Direct Fire Lethality Program, and other light forces weapon enhancements, like the Precision Guided Mortar Munition (PGMM). The PGMM demonstration will feature an affordable laser guided mortar munition with an extended range glide capability that will double mortar range capabilities and dramatically improve mortar accuracy. Weapon demonstrations are vital to assessing new tactics and technologies for early entry forces. Towed howitzer fire control enhancements applicable to both Army and Marine Corps artillery requirements are included under the RFPI ACTD. A key RFPI ACTD Integrated Acoustic Sensor (IAS) system will be evaluated. Smart munition sensor technologies capable of locating targets in clutter applicable to next generation smart munitions will also be evaluated. Most of these concepts being demonstrated are candidates for technology insertions and most provide significant enhancement to early entry forces. FY 2000 and FY2001 funding will support the area denial technology demonstration scheduled for FY 2001. In-house efforts are accomplished by the Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp. (SAIC), McLean, VA; LTV Aerospace, Dallas, TX; Textron, Lowell, MA; Ferrulmatic, Inc., Totowa, NJ; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; Olin-Flinchbaugh, Red Lion, PA; Textron, Inc., Willington, MA; Technical Solutions Incorporated (TSI), Mesina Park, NM; Motorola, Scottsdale, AZ; Lockheed Martin, Orlando, FL; MEI Technology, Lexington, MA; Computing Device International, Minneapolis, MN; Singer Kearfott, Wayne, NJ; Diehl GmbH., Rothenbach, Germany.

FY 1998 Accomplishments:

- 5160 - Completed PGMM advanced technology demonstration (ATD) seeker captive flight testing.
  - Conducted PGMM fin deployment and launch environment fire tests.
- 2661 - Completed testing of towed howitzer fire control for safety release.
  - Developed tactics, techniques and procedures for the 155mm automated howitzer.
  - Upgraded one battery with digitized fire control system; conducted RFPI field experiment.
  - Completed evaluation of the RFPI IAS system.

Total 7821

FY 1999 Planned Program:

- 4849 - Conduct PGMM wing deployment live fire tests; conduct laser sensor trade studies; participate in the Military Operations in Urban Terrain (MOUT) ACTD via simulation.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603004A Weapons and Munitions Advanced Technology
	PROJECT D43A

FY 1999 Planned Program: (continued)

- 808 - Support automated towed howitzer extended user evaluation under the RFPI ACTD.
- 2438 - Fabricate hardware for electro-rheological fluid recoil system testbed 2 for the Advanced Technology Lightweight Artillery System (ATLAS).
- 1463 - Complete integrated design of dual novel penetrator system for defeat of future armor targets with less than 5 megajoules of energy on target.
  - Demonstrate optical fiber muzzle reference sensor capability to continuously measure gun tube flexure.
- 3560 - Conduct fire control system definition for launching extended range munitions.
  - Complete detailed system designs.
  - Downselect to one or two designs for demonstration phase.
- 227 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 13345

FY 2000 Planned Program:

- 10057 - Conduct sub-system demonstrations of Tank Extended Range Munition (TERM) using simulation and live-fire, and refine the concept.
  - Complete guide-to-hit demonstration for TERM.
- 6108 - Conduct PGMM ATD range and stability demonstration fires; conduct PGMM Global Positioning System (GPS) evaluation.
  - Conduct simulation and modeling effort for area denial; procure and test prototype weapon system and sensor hardware.
- 7402 - Complete automated towed howitzer extended user evaluation under the RFPI ACTD.
  - Define combined laser detection and ranging (LADAR), millimeter wave radar and infrared sensor suite requirements to detect low observable targets; conduct captive flight test to evaluate WBAND (94 gigahertz) millimeter wave radar and LADAR sensor suite for next generation smart munition applications.
  - Conduct ATLAS live fire demonstration of 6750 lb. weapon; begin fabrication of 5700 lb. weapon.
- 2118 - Conduct integrated demonstrations of novel dual penetrator systems to establish enhanced defeat of complex armor with less than 5 megajoules of energy on target.

Total 25685

FY 2001 Planned Program:

- 3349 - Demonstrate capability of hitting stationary and moving targets with TERM.
  - Demonstrate defeat of advanced threat armors and active protection systems through simulation and/or live fire.
- 4896 - Conduct demonstrations of advanced turret with precision stabilization in live-fire demonstrations.
  - Complete dual role ammunition and gearless turret development.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603004A Weapons and Munitions Advanced Technology PROJECT D43A

- 3764 - Conduct PGMM ATD laser round demonstration firings.
  - Build and test area denial hardware and conduct system demonstration.

FY 2001 Planned Program: (continued)

- 4973 - Perform operational evaluation of 5700 lb. ATLAS weapon.
- 5000 - Develop aiming algorithm to support real time processing in a captive flight test (CFT) for LADAR/infrared/millimeter wave sensor suite
  - Conduct CFT to validate detection capability against low observable targets.

Total 21982

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603004A Weapons and Munitions Advanced Technology

PROJECT: D232

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D232 Advanced Munitions Demonstration	10252	11513	14208	16704	12991	15186	16470	16738	Continuing	Continuing

Mission Description and Justification: This project includes the Direct Fire Lethality (DFL) program which will enhance tank kinetic energy (KE) penetrator lethality, particularly against explosively reactive armor (ERA) appliqué arrays now available on fielded threat systems, through use of a precursor defeat mechanism. The program will demonstrate range and lethality enhancements for tank munitions and demonstrate the emerging technologies needed to defeat the active protection system (APS) threat. In the near term, this project demonstrates advanced warhead and cartridge concepts, utilizing novel explosively formed penetrators (EFP) and shaped charged designs, that can be applied to product improvements to fielded and developmental anti-armor munitions, (e.g., autonomous intelligent submunition (AIS) Damocles, wide area munitions (WAM), smart target activated fire and forget (STAFF), 120mm chemical energy (CE) cartridge and the Sense and Destroy Armor (SADARM) submunition. It advances warhead technology to enhance the lethality of smart projectiles by providing multi-role, multi-effect warheads capable of defeating point and area targets. This project will fund demonstrations of advanced fuzes for near term munitions concepts. Low Cost Competent Munition (LCCM) concepts integrating global positioning system (GPS) into fuzing are being developed for artillery projectiles. The resulting screw-on module and ground receiver will significantly increase a projectile's overall delivery accuracy and also be readily applicable to the existing stockpile of 155mm artillery projectiles. In-house efforts are accomplished by Armament Research Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp. (SAIC), McLean, VA; LTV Aerospace, Dallas, TX; Textron Defense Systems, Wilmington, MA; Ferrulmatic, Inc., Totowa, NJ; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; and Olin-Flinchbaugh, Red Lion, PA.

FY 1998 Accomplishments:

- 4550 - Completed DFL ATD precursor integrated concept demonstrations.
  - Downselected precursor technology to achieve optimum defeat capability of ERA targets.
  - Demonstrated feasibility to improve flight dynamics of KE penetrators to achieve 70% probability of hit improvement at 3 kilometers and performed armor tests for 120mm tank ammunition.
- 1126 - Evaluated extended range munitions concepts and developed detailed system designs.
- 4115 - Completed full-up real time system demonstration of LCCM auto-registration system; developed hardware and software interfaces with Paladin, M198 and M109A5 self-propelled howitzer platforms; developed fire control system hardware and software changes to accommodate auto-registration system.
  - Demonstrated Integrated Acoustic System (IAS) for the Rapid Force Projection Initiative (RFPI), a target detection system to support early entry forces' "stand off killer" concepts.
- 461 - Competitively bought long stand-off warhead candidate for Government testing in FY 1999.

Total 10252

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603004A Weapons and Munitions Advanced Technology PROJECT D232

FY 1999 Planned Program:

•	5114	- Complete DFL ATD precursor penetrator integrated cartridge design. - Conduct technology maturation demonstrations for optimum novel penetrator function and armor penetration utilizing tactical composite sabot and propulsion system.
•	3419	- Complete extended range munitions design, downselect, and conduct critical subsystem demonstrations.
•	2754	- Conduct tests of downselected warheads from FY 1998 and develop as candidate for counter active protection system.
•	226	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	11513	

FY 2000 Planned Program:

•	6500	- Complete integrated cartridge design of advanced kinetic energy (KE) cartridge for the Abrams tank capable of defeat of explosive reactive armor.
•	7708	- Demonstrate guide-to-hit munitions for Tank Extended Range Munition (TERM).
Total	14208	

FY 2001 Planned Program:

•	10204	- Demonstrate fire control sub-system for TERM.
•	6500	- Complete demonstration of KE defeat of explosive reactive armor.
Total	16704	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603004A Weapons and Munitions Advanced Technology

PROJECT: D233

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D233 Trajectory Correctable Munitions Development	5621	0	0	0	0	0	0	0	0	5621

Mission Description and Justification: This project funds a Congressionally mandated trajectory correctable munition (TCM) program called the XM982 Extended Range Artillery projectile. This munition will provide the Army with a versatile projectile with unprecedented range and accuracy and will significantly extend the capabilities of both current and developmental 155mm artillery platforms. Program management is conducted by the Project Manager for Sense and Destroy Armor (SADARM) and in house efforts are primarily conducted by the Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ.

FY 1998 Accomplishments:

- 621 - Provided government support for engineering, integrated product team (IPT), and source selection efforts for the XM982 engineering, and manufacturing development (EMD) contract.
- 5000 - Completed preliminary design and testing of XM982 dual-purpose improved conventional munitions (DPICM) extended range projectile, payload, instrumentation and guidance systems.

Total 5621

FY 1999 Planned Program: This project is not funded in FY 1999.

FY 2000 Planned Program: This project is not funded in FY 2000.

FY 2001 Planned Program: This project is not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603005A Combat Vehicle and Automotive Advanced Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	38694	61300	90941	97200	61779	68190	71812	77042	Continuing	Continuing
DC62 DC62	14007	16955	0	0	0	0	0	0	0	85806
DC66 DC66	0	0	967	952	956	952	1008	1037	Continuing	Continuing
D221 Combat Vehicle Survivability	666	687	20588	18483	15898	9445	11730	15067	Continuing	Continuing
D440 Advanced Combat Vehicle Technology	5942	24283	55470	65487	26843	31959	36761	35767	Continuing	Continuing
D441 Combat Vehicle Mobility Technology	2805	4799	8136	7502	9796	14639	16383	13607	Continuing	Continuing
D497 Combat Vehicle Electronics	5813	7324	5780	3003	5628	6275	5930	11564	Continuing	Continuing
D502 HAECO II	0	795	0	0	0	0	0	0	0	800
D506 Aluminum Metal Matrix Composite (NAC)	6089	3974	0	0	0	0	0	0	0	10089
D507 PLS Commercial Engine (NAC)	3372	2483	0	0	0	0	0	0	0	5872
D515 Robotic Ground Systems	0	0	0	1773	2658	4920	0	0	0	9351

A. Mission Description and Budget Item Justification: This Program Element (PE) demonstrates the operational potential of advanced combat vehicle component technologies which can contribute to upgrades of fielded combat vehicles and advanced ground combat vehicle systems. It places emphasis on solutions to post-Cold War deficiencies, providing opportunities for more affordable, deployable, survivable, horizontally integrated and lethal power projection capabilities than are currently available. The technology areas supported by this program element include: vehicle survivability, mobility, intra-vehicular digital electronics, and integration of diverse vehicle technologies developed by the Army, other DoD laboratories and industry. These technologies are demonstrated to and experimented by various Army warfighter organizations through a series of vehicle component and system level technology demonstrations. Work in this program element is consistent with the Army Science and Technology Master Plan, Science and Technology Objectives, Army Modernization Plan, and the Ground and Sea Vehicle Defense Technology Area Plan (DTAP). This

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603005A Combat Vehicle and Automotive Advanced Technology**

program is managed primarily by the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI. This program 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 and fully coordinated with PE 0602601A (Combat Vehicle and Automotive Technology) and contains no unwarranted duplication of effort among the Military Departments. Furthermore, the project is coordinated with the Marine Corps office within the Naval Surface Warfare Center, the Naval Research Lab, Air Force Armaments Command, and ground vehicle developers within the Departments of Energy, Commerce, Transportation, and the Defense Advanced Research Projects Agency (DARPA).

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	40796	54435	89083	99907
Appropriated Value	42242	61735		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1303	-435		
b. SBIR / STTR	-895			
c. Omnibus or Other Above Threshold Reductions	-1298			
d. Below Threshold Reprogramming	-52			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1858	-2707
Current Budget Submit (FY 2000 / 2001 PB)	38694	61300	90941	97200

Change Summary Explanation: Funding – FY 1999 – Congressional add (+7300).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603005A Combat Vehicle and Automotive Advanced Technology

PROJECT: D221

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D221 Combat Vehicle Survivability	666	687	20588	18483	15898	9445	11730	15067	Continuing	Continuing

Mission Description and Justification: This project demonstrates advanced technologies for protection against threats to ground combat vehicles (e.g., smart, precision guided and other munitions). Project DC62 has been restructured by transferring its funds into this project starting in FY00. The Army has concentrated active protection system demonstration in this project. Efforts will be focused on demonstrating the necessary threat sensors, software algorithms, and hard kill countermeasures needed for an active protection system (APS) that is initially effective against chemical energy (CE) munitions (e.g., shaped charge warheads), with an ultimate goal of demonstrating an effective countermeasure against kinetic energy (KE) (i.e., long rod). Defeat of KE threats by an APS poses an especially difficult challenge due to the velocity, small cross section and robustness of the long rod penetrator. APS is viewed as having tremendous potential for providing enhanced protection of all combat vehicles and is an especially attractive solution for lightweight vehicle classes. Under the APS demonstration program, the Army will evaluate several competing approaches. One of these is a Congressionally directed evaluation of a foreign vehicle self-protection system. Survivability technologies that are integrated and demonstrated under this project include those transitioned from the following exploratory developmental programs: active protection countermeasure technology development PE 0601102A (Defense Research Sciences)/ Project AH43 and BH57; sensors and countermeasures PE 0602270A (Electronic Warfare Technology)/ Project A442. Major contractors include: United Defense LP. of San Jose (prime), CA; Sanders, a Lockheed Martin Company in Nashua, NH.; TRW of Redondo Beach, CA.; Dynetics, Inc. in Huntsville, AL; Hughes Danbury, Danbury Conn.; Chang Industries, LaVerne, CA.

FY 1998 Accomplishments:

- 666 - Classified program support.

Total 666

FY 1999 Planned Program:

- 685 - Classified program support.
- 2 - Funds reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Authorization Act of 1992.

Total 687

FY 2000 Planned Program:

- 1001 - In-house government support for active protection system (APS) contract.
- 19167 - Initiate detailed design, and perform APS development and testing under contract with United Defense Limited Partnership (UDLP)
  - Complete critical drawings and initiate fabrication of APS by contractor.

- Conduct component integration of all sensors and countermeasures integrated electronically and tested in subcontractor subsystem systems integration laboratory (SIL).

FY 2000 Planned Program: (continued)

- Initiate vehicle system integration with all subsystems integrated on vehicle platform; integrate software into vehicle platform and check for functionality and safety; exercise overall system on contractor vehicle SIL.

•	80	- Other government agency support.
•	40	- Purchase threat munitions test assets.
•	300	- Systems engineering support (Booz Allen Hamilton / ICRC Energy).
Total	20588	

FY 2001 Planned Program:

•	1153	- In-house government support.
	16698	- Continue APS development and testing under contract with UDLP; begin APS component integration.
		- Continue vehicle system integration and complete final in-shop checkout.
		- Perform system and subsystem performance testing with software safety and functionality test in field; perform emulation and simulation tests to incrementally exercise the system and test all functional attributes and debug software as necessary; perform live threat defeat to quantify system level performance; assess functional integration, sensor fusion, and countermeasure selection and performance.
•	200	- Other government agency support.
•	170	- Test support.
•	262	- Systems engineering support (Booz Allen Hamilton / ICRC Energy).
Total	18483	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603005A Combat Vehicle and Automotive Advanced Technology

PROJECT: D440

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D440 Advanced Combat Vehicle Technology	5942	24283	55470	65487	26843	31959	36761	35767	Continuing	Continuing

Mission Description and Justification: This project demonstrates the operational potential, technical feasibility and maturity of advanced combat vehicle technologies for potential product improvements to currently fielded and next generation combat vehicles. The objectives are to demonstrate innovative combat vehicle configurations, technologies and integration techniques through Integrated Product and Process Development (IPPD) yielding hardware technology demonstrations, computer simulations and full-scale demonstrations, to accomplish a more rapid and seamless transition of advanced technologies to systems applications. All demonstrations include user and developer teaming in field and/or laboratory environments. The major near term initiative funded by this project is the Future Scout and Cavalry System (FSCS) Advanced Technology Demonstration (ATD), which transitioned from applied research PE 0602601A (Combat Vehicle and Automotive Technology) to this project in FY98. This ATD integrates advanced technologies, including sensors, survivability, advanced mobility technologies and communications into a robust vehicle platform. The FSCS ATD will then undergo technical and user evaluations. The FSCS ATD is a joint United States/United Kingdom FSCS/Tactical Reconnaissance Armored Combat Equipment Requirement (TRACER) program. A Memorandum of Understanding (MOU) was signed in July 1998. The acquisition strategy for the ATD is for both countries to fund equal shares and to award contracts to two competitive US/UK consortia. The request for proposal (RFP) has been released with contract award expected in January 1999. Both countries have harmonized the User Requirements and a planned joint three-star review is planned 24 months after contract award to review and approve the final operational trade-offs prior to finalizing the ATD design configuration. Two consortia have submitted proposal. They are: SIKA Team (Lockheed Martin/British Aerospace joint venture with General Dynamics Land Systems, Vickers, and Northrup Grumman as subcontractors); LANCER Team (GEC Marconi prime contractor with United Defense Limited Partnership, GKN Defense and Raytheon Systems as subcontractors). This project funded the Composite Armored Vehicle (CAV) ATD through FY 98. The impressive results of the CAV ATD have resulted in a technology insertion, by PM Crusader, of composite technology into the Crusader design. This change has saved approximately one ton of weight in the Crusader turret design. United Defense, Limited Partnership, San Jose, CA was the prime contractor for the CAV ATD.

FY 1998 Accomplishments:

•	1571	- Completed CAV ATD 3000 mile durability testing, final report.
•	2000	- Transferred composite technology to the Crusader for turret design implementation.
•	2371	- Developed and allocated FSCS ATD design tradeoffs down to subsystems for affordability trade-off studies.
		- Negotiated and approved FSCS/TRACER MOU with UK.
		- Harmonized joint UK/US system specification for RFP, and issued RFP.
Total	5942	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology PROJECT D440

FY 1999 Planned Program:

•	19261	- Conduct source selection and award FSCS ATD contracts to two US/UK consortia to complete FSCS preliminary design and interface control, begin detailed design, develop FSCS/TRACER vehicle concepts for engineering models, begin development of FSCS ATD hardware and software, perform weapon systems trade-off studies and begin weapon systems development for FSCS/TRACER. - Transition the implementation of vehicle electronics (VETRONICS) open systems architecture (VOSA) to the FSCS ATD contractors. - Begin development of electronic interfaces between major subsystems of FSCS/TRACER (e.g., target acquisition, communication, crew control and displays, etc.) and incorporate sensor suite, crew station, and electronic interface into contractors design/systems integration laboratory (SIL) for FSCS ATD.
•	4431	- Conduct system requirement analysis for C41 workload - Initiate effort to implement simulation and modeling c0oncepts to support FSCS ATD contractor efforts. - Support and participate in Government/contractor integrated product teams (IPTs). - develop model to enable Government and contractor s to determine system cooling requirements given vehicle and propulsion system characteristics.
•	591	- Funds reprogrammed for SBIR//STTR programs in accordance with the Small Business Innovation Research Program Authorization Act of 1992.
Total	24283	

FY 2000 Planned Program:

•	19376	- Evaluate the affordability of hardware and software alternatives and system concepts by both contractors. - Complete sub-system and system trade studies to define cost effective hardware configurations by both contractors. - Develop FSCS simulations and virtual prototypes by both contractors. - Define software requirements by both contractors. - Conduct Ministry of Defense/Department of Defense System Design Reviews
•	27194	- Procure hardware and initiate fabrication of sub-system assemblies by both contractors. - Design, procure and assemble system integration laborites (SIL) by both contractors. - Initiate sub-system testing and evaluation by both contractors. - Initiate analysis of survivability design alternatives by both contractors.
•	5900	- Perform Cost as an Independent Variable (CAIV) analysis and trade studies. - Complete analysis to support refinement of Combined Operational Requirements Document requirements. - Complete Cooperative Analysis of Alternatives (CAoA) to support 3-Star Review. - Continue support and participation in Government/contractor IPTs.
•	3000	- Continue modeling and simulation concepts in support of FSCS ATD contractor efforts.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology
	PROJECT D440

- Investigate application of Joint Tactical Radio System (JTRS) to FSCS.

Total 55470

FY 2001 Planned Program:

- 19221 - Complete all trade studies and finalize cost effective alternatives by both contractors.
  - Provide affordability data for US/UK 3-Star Affordability Review by both contractors.
  - Incorporate simulation and virtual prototyping results into their development process by both contractors.
  - Complete sub-system and SIL fabrication by both contractors.
- 38866 - Perform demonstrator vehicle fabrication and integration by both contractors.
  - Fabricate and evaluate survivability designs by both contractors.
  - Complete sub-system test and evaluation by both contractors.
  - Initiate contractor system shakedown test and evaluation efforts by both contractors.
- 7400 - Prepare and conduct 3-Star Affordability Review.
  - Prepare and release RFP for engineering and manufacturing development (EMD) phase.
  - Participate in contractor system and sub-system testing and evaluation.
  - Continue support and participation in Government/contractor IPTs.

Total 65487

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603005A Combat Vehicle and Automotive Advanced Technology

PROJECT: D441

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D441 Combat Vehicle Mobility Technology	2805	4799	8136	7502	9796	14639	16383	13607	Continuing	Continuing

Mission Description and Justification: This project demonstrates the mobility technologies (suspension , track, engines, transmissions, and auxiliaries) vital for lighter, more fuel efficient, more agile, more deployable ground combat vehicles. It funds an advanced mobility technology demonstration comprised of several independent demonstrations. The principal elements of the mobility demonstration in FY99 are active and semi-active suspension, electric drive, and lightweight track. Military requirements for vehicle mobility are unique because of (1) a need for a stable, smooth ride at high speeds (greater than 20 mph) over rough, cross country terrain, (2) a need for the mobility components to be as small and as light as to enable compact vehicle designs that are less vulnerable to detection, acquisition and attack by threat weapons, and (3) a need to protect vehicle subsystems under armor, which complicate the design of engine air intake and exhaust systems. High speed is required to accomplish the maneuver-dominant warfare envisioned in the Air-Land battle doctrine. A smooth ride is necessary for weapon targeting on the move and for crew comfort and endurance, which are features embedded in U.S. doctrine. The lighter and smaller vehicles are necessary for enhancing deployability and lessening the logistics burden (fuel), but lighter vehicles will have significantly degraded ride performance and mobility limits compared to larger, heavier vehicles without new mobility technology advances. For the next decade, the mobility thrusts required to compensate for smaller and lighter systems are: electric drive (small internal propulsion size and weight), active suspension (increased vehicle stability and higher speed on rough terrain), compact efficient transmissions and lightweight track (reduced system weight and track noise). Electric drive offers unique new capabilities, such as high torque and quiet operation; however, it presents new challenges, especially in cooling of electronic components. Work in this area is being closely coordinated with DARPA's electric drive and Combat Hybrid Power System (CHPS) programs. The latter program will transition to this Army project in FY00. The objective of the CHPS program is to design, develop and demonstrate, in a System Integration Lab (SIL), a robust electrical power architecture that can meet the requirements of future vehicles ranging from light tactical wheeled vehicles to close combat vehicles. In-house efforts are accomplished by the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Other government agencies include: Waterways Experiment Station, Vicksburg, MS; Army Research Laboratory, Adelphi MD. Major contractors include: General Dynamics Land Systems Muskegon Operations, Muskegon, MI; Pentastar Huntsville, AL; United Defense Limited Partnership, San Jose, CA; Michigan Technological University, Houghton MI; General Electric, Schenectady, NY; Cadillac Gage Textron, New Orleans, LA.

FY 1998 Accomplishments:

- 1805 - Developed and installed preview sensor algorithms into active suspension control system on a High Mobility Multipurpose Wheeled Vehicle (HMMWV) test rig.
  - Performance tested semi-active suspension and durability/performance tested band track system in support of FSCS ATD.
- 1000 - In coordination with DARPA, completed integration of hybrid electric drive components into a 30 ton hybrid electric demonstrator in preparation for test and evaluation.
  - Designed compact high efficiency mechanical transmission.

Total 2805

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology
	PROJECT D441

FY 1999 Planned Program:

•	3763	- In coordination with DARPA and Army Research Laboratory (ARL), test and evaluate Silicon Carbide (SiC) power devices for motor drive controller. - Field test active suspension with preview sensor and algorithms. - Test track tensioning system for medium combat vehicle application. - Fabricate compact high efficiency mechanical transmission.
•	959	- In coordination with DARPA, integrate and test CHPS architecture components into a System Integration Laboratory (SIL).
•	77	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	4799	

FY 2000 Planned Program:

•	3379	- Configure and install on HMMWV optimal preview sensor for active suspension. - Procure, install and evaluate kinetic suspension on HMMWV. - Install the electric drive components of the combat hybrid power system on a mobility tested. - Refine and demonstrate the design of SiC motor drive controller. - Perform shakedown and limited durability testing of compact, high efficiency mechanical transmission.
•	2757	- Transition the CHPS SIL and Virtual Prototype from DARPA to the Army/TARDEC. - Update the DARPA CHPS Virtual Prototype models based upon information obtained from SIL assessments. - Complete the DARPA CHPS program by demonstrating in the SIL the feasibility of a hybrid architecture.
•	2000	- Begin integration of advanced components (composite flywheels, high temperature/fast response converters and advanced high energy density batteries) in CHPS for assessment in the SIL.
Total	8136	

FY 2001 Planned Program:

•	2714	- Test and refine preview feature of an active suspension system. - Demonstrate and test the combat hybrid power system hardware on a mobility test bed. - Conduct performance and evaluation tests on compact, high efficiency transmission. - Fabricate turbocharger, high temperature tribology componentry, cold start system and fuel injection system for application to commercial diesel engines for combat vehicles.
•	3084	- Develop new system level and component level vehicle power requirements based on the next planned Army combat vehicle. - Allocate these requirements down to the vehicle hybrid electric power architecture.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology
	PROJECT D441

- Using the CHPS virtual prototype modeling tools, design vehicle-specific hybrid electric architecture.

FY 2001 Planned Program: (continued)

•	1704	- Complete integration and demonstration of advanced components (composite flywheels, high temperature/fast response converters and advanced high energy density batteries) in CHPS for performance assessment in the SIL.
Total	7502	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603005A Combat Vehicle and Automotive Advanced Technology

PROJECT: D497

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D497 Combat Vehicle Electronics	5813	7324	5780	3003	5628	6275	5930	11564	Continuing	Continuing

Mission Description and Justification: This project develops and demonstrates vehicle electronics hardware and software technologies that will yield increased crew efficiencies and performance or reduced crew size and advances open systems architectures for ground vehicle weapon systems. These technologies include: three-dimensional (3D) audio, voice recognition, headtrackers, advanced software architecture, reusable software Application Program Interface (API) s, embedded simulation, and indirect and semi-autonomous driving (using available robotics technologies). Investments: in embedded training, mission rehearsal, decision aids, automation of crew functions, and ergonomic crew station designs enhances training, leadership and soldier (TLS). The program will be conducted in three phases that continually build on advancing technologies into a mobile reduced crew testbed vehicle. The first phase will develop and integrate 3D audio, voice recognition, a commander's headtracker, and an initial open systems architecture/software API and embedded simulation baseline into the testbed. It will culminate in a FY00 vehicle demonstration of a 50% crew efficiency enhancement, a 15% reduction in software cost with a 5X improvement in architecture throughput and embedded simulation integration feasibility. The second phase will advance the voice recognition, architecture/API and embedded simulation baseline and develop and integrate the semi-autonomous robotics technologies into the testbed. It will culminate in an FY04 vehicle demonstration of a 100% increase in crew efficiency (or 50% reduction in crew size) by driving and commanding the vehicle from a single crew station, a 30% reduction in software cost with a 10X increase in architecture throughput, and embedded simulation capable of full mission rehearsal. This program will build on and leverage technologies from the Future Scout and Cavalry System (FSCS) Advanced Technology Demonstrator (ATD), the Joint Robotics Program Demo III Program, the Crusader and the Crewman's Associate ATD. Major contract efforts will include: DCS Corp, Alexandria, VA, for software architecture; Oasis, Troy, MI, for embedded simulation; RST, Westminster, MD, and Utah State for robotics technologies; and GDLS, Sterling Heights, MI, for testbed integration and voice recognition.

FY 1998 Accomplishments:

- 3000 - Supported FSCS for electronics requirement definition.
- 200 - Defined operating environment API and architecture baseline for reduced crew testbed.

1200 - Demonstrated and delivered FSCS conceptual crew station simulator to Mounted Warfare Battlelab (MWBL) and Directorate of Combat Development (DCD), Ft Knox, for user evaluation.

213 - Demonstrated three-dimensional audio technologies in crew station simulator.

300 - Defined mobile reduced crew testbed concept and acquired vehicle.

900 - Developed ground vehicle map server software to standard API.

Total 5813

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology PROJECT D497

FY 1999 Planned Program:

•	250	- Design vehicle test bed system electronics architecture.
	4180	- Evaluate, select, and procure 3D audio, headtracker, voice recognition, indirect vision driving, architecture and embedded simulation technologies.
	900	- Define testbed software architecture and top level software design; design and code the common software operating environment based on real time Common Object Request Broken Architecture (CORBA).
	100	- Conduct solid modeling analysis of crew station structure and positioning within testbed vehicle; define and design crew station for commander/driver.
	180	- Prepare test bed for crew station mechanical integration.
	600	- Define and design graphical operating environment and reusable combat vehicle graphics tool kit.
	700	- Define and design vehicle test bed embedded simulation system; procure embedded simulation image generation hardware.
	150	- Define and design test environment equipment and scenario.
	100	- Procure Pos/Nav and GPS system, mass memory unit, and intercom system for test bed vehicle.
•	164	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	7324	

FY 2000 Planned Program:

•	1600	- Complete and integrate crew stations into testbed.
	1800	- Complete software development, code and test of: mission rehearsal, graphics tool kit, graphics operating environment, user interface device drivers, drive by wire algorithms, commanders Graphics Usr Interface (GUI) and test simulation functions.
	650	- Complete unit test and systems integration testing of test bed vehicle systems.
	270	- Integrate and test technologies into vehicle testbed.
	200	- Prepare test site for vehicle demo.
	220	- Integrate synchronized Modular Semi-Automated Forces (MODSAF) and after action review software into embedded simulation system.
	490	- Create 3D visual terrain data base of test site and integrate database into test bed vehicle.
	550	- Demonstrate indirect vision, voice recognition, three-dimensional audio, advanced architecture and embedded simulation technologies in vehicle testbed.
Total	5780	

FY 2001 Planned Program:

•	3003	- Conduct vehicle test bed data reduction, test results analysis and identify lessons learned. - Synthesize lessons learned into Phase II test bed vehicle requirements.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology
	PROJECT D497

- Design advanced architecture and embedded simulation system.

FY 2001 Planned Program (continued)

- Define semi-autonomous driving concept and initiate design.
- Design commander/driver crew station.
- Define requirements and concept for vehicle remote control for dismounted operations.
- Define and evaluate a second crew station and define gunnery functions.

Total 3003

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology PROJECT D502

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D502 HAECO II	0	795	0	0	0	0	0	0	0	800

Mission Description and Justification This Congressionally-directed project, that was funded in FY95 and FY97, supports continued development and Army testing of the combined diesel/turbine (giesel) prototype engine. The Army has contracted with the Hope-Anderson Engine Company (HAECO) to development one giesel engine in the 300 to 600 horsepower range for delivery to the Army for testing at the U.S. Army Tank-Automotive and Armaments Command (TACOM). The contractor is HAECO Partners Ltd., Hillsboro, Ohio.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program:

- 415 - Complete development of giesel prototype engine for Government evaluation.
- 279 - Perform government tests and evaluations at TACOM.
- 80 - Participate in Simulation Based Acquisition demonstration for the Total Life Cycle (SIM-TLC).
- 21 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 795

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603005A Combat Vehicle and Automotive Advanced Technology

PROJECT: D506

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D506 Aluminum Metal Matrix Composite (NAC)	6089	3974	0	0	0	0	0	0	0	10089

Mission Description and Justification: This congressionally directed program provides funds to investigate Aluminum Metal Matrix Composite materials for military system applications. Interest in this technology stems from the Army's desire for stronger, lighter track shoes as well as other applications, such as engine components. The project addresses the technologies needed to develop manufacturable ground vehicle track components to reduce weight and life cycle costs using metal matrix composites in place of traditional metals. Cost and weight reductions may be possible in some applications.

FY 1998 Accomplishments:

- 6089 - Developed a single pin aluminum metal matrix track design that is interchangeable with the Bradley Fighting Vehicle for both Operations and Support cost reductions and weight savings of 25%.
  - Manufactured prototype ground vehicle track components.

Total 6089

FY 1999 Planned Program:

- 3472 - Complete mechanical and wear testing of silicon carbide reinforced aluminum metal matrix samples to determine material properties; complete preliminary design of single pin track shoe for Bradley vehicle; complete manufacturing development work for a single pin track shoe for the Bradley vehicle.
- 397 - Participate in Simulation Based Acquisition demonstration for the Total Life Cycle (SIM-TLC).
- 105 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3974

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603005A Combat Vehicle and Automotive Advanced Technology
	PROJECT D507

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D507 PLS Commercial Engine (NAC)	3372	2483	0	0	0	0	0	0	0	5872

Mission Description and Justification: This congressionally directed program demonstrates a heavy truck propulsion system through the leveraging and utilization of commercial engine technologies. This program supports the Program Manager for Heavy Tactical Vehicles (PM HTV) acquisition plans for heavy truck propulsion systems future pre-production contract(s) in 2002, and production contract(s) in 2004. This effort is intended to assure a complementary blend of propulsion capabilities and engine configurations based on both commercial market forces and military requirements is achieved. The Army has not budgeted any funding beyond FY99.

FY 1998 Accomplishments:

- 3372 - Initiated cooperative agreements with one major heavy diesel engine manufacturer to develop high horsepower, EPA certified engines with improved emissions for the heavy tactical truck fleet with potential applicability to medium combat vehicles.

Total 3372

FY 1999 Planned Program:

- 2169 - Conduct a competitive solicitation to upgrade the level of technology and to provide additional improvement in the reduction of harmful emissions (All major engine manufactures are being invited to submit proposals).
  - Complete engine evaluation.
- 248 - Participate in Simulation Based Acquisition demonstration for the Total Life Cycle (SIM-TLC).
- 66 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2483

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603005A Combat Vehicle and Automotive Advanced Technology

PROJECT: D515

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D515 Robotic Ground Systems	0	0	0	1773	2658	4920	0	0	0	9351

Mission Description and Justification The project funds demonstrations of unmanned land systems for multiple tactical and logistics applications by the Army and, possibly, other services. The Army has evaluated concepts for robotic systems in simulations, and these systems have been shown to provide important capabilities. The near term efforts are oriented on an unmanned companion, called a robotic follower, to manned combat vehicles. The robotic follower is envisioned as a fighting vehicle that might also transport ammunition and other materiel for its manned counterparts. A robotic follower concept with great potential is armed with long range (12-16km) non-line-of-sight missiles. The advantages of using robotic platforms in this way include the capability to carry more munitions than a comparable manned systems (due to larger available interior volume) and removal of the firing signature from manned systems in most cases. The Army's approach is to build upon previous and ongoing investments, such as the Demo III program, under the Joint Robotics Program, and the Crewman's Associate ATD. In addition to the robotic follower, the Army user has interest in robotic platforms to augment manned, ground and aerial reconnaissance systems, and robotic sentries for tactical headquarters and logistics nodes. Technologies proven in any robotic demonstration are expected to be transferable to other unmanned platforms as well as manned platforms to reduce operator work load.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program:

- 1773 - Begin vehicle design and define technology interfaces with Army Research Laboratory and Industry; award primary vehicle integration contract.

Total 1773

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603006A Command, Control and Communications Advanced Technology

	COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	24884	23747	20883	21508	22916	22604	26275	26272	Continuing	Continuing
0247	Tactical C4 Technology Integration	7542	12393	11400	10395	12925	12808	14941	14942	Continuing	Continuing
D257	Digital Battlefield Communications	8092	4937	4749	4823	5787	5493	6519	6033	Continuing	Continuing
D592	Space Applications Technology	2716	2443	4734	6290	4204	4303	4815	5297	Continuing	Continuing
D596	Field Laser Radar Demo	4661	0	0	0	0	0	0	0	0	9630
D597	Wave Net Technology	1873	0	0	0	0	0	0	0	0	3844
D617	Global Broadcast System (GBS) Information Management	0	3974	0	0	0	0	0	0	0	3974

A. Mission Description and Budget Item Justification: This program element consists of projects that will advance command, control, and communications (C3) technology to provide the soldier with high quality real-time battlefield information and integrate space technologies into Army tactical applications. The tactical C4 technology integration project provides software application development demonstrations, communications system integration and prototype products for distributed, mobile, secure, fully automated spread spectrum radio networks with measures to enhance the survivability and efficiency of Army tactical command, control, communications and computer (C4) systems. This program specifically addresses joint service demonstrations coordinated through the joint directors of laboratories, Information Systems and Technology Panel for C4, and provides key demonstrations of systems integration across the Army's battlefield functional areas. Work in this PE will provide multimedia inter networked communications while on-the-move with commercial standard gateway connectivity to both high-speed and legacy communications assets. This program also tests and evaluates net radio, common user, and distributed communications equipment and automated spectrum management aids which have potential to solve user needs; tests and evaluates equipment deficiencies; and provides critical future capabilities and supports new radio development and evaluation, in conjunction with the Defense Advanced Research Projects Agency (DARPA) and the Air Force (AF). The digital battlefield communications project will support the Army's battlefield digitization effort by demonstrating technology to integrate communications hardware and software capable of providing seamless communications for the digitized battlefield to meet emerging requirements for high-capacity/on-the-move information exchange and leading to a battlefield information transmission system for Force XXI. The space applications technology project will demonstrate novel applications of space assets for Army missions and support space technology integration. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this program element is related to and fully coordinated with efforts in PE 0602782A (Command, Control and Communications Technology),

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603006A Command, Control and Communications Advanced Technology**

PE 0203740A (Maneuver Control System), PE 0203726A (Advanced Field Artillery Tactical Data System), 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) in accordance with the ongoing Reliance Joint planning process.). These efforts contain no unwarranted duplication of effort among the Military Departments.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	25708	20109	19538	19008
Appropriated Value	26688	24109		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-980	-362		
b. SBIR / STTR	-620			
c. Omnibus or Other Above Threshold Reductions	-204			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1345	+2500
Current Budget Submit (FY 2000 / 2001 PB)	24884	23747	20883	21508

Change Summary Explanation: Funding – FY99 funding (+4000) for Project D617 change due to Congressional increase.
FY00 Adds funding to battlefield ordnance awareness project to collect data and conduct analysis to meet national system accelerated schedule requirements.
FY01 Adds funds to space surveillance project to complete threat database and assessment algorithms.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603006A Command, Control and Communications Advanced Technology

PROJECT: 0247

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
0247 Tactical C4 Technology Integration	7542	12393	11400	10395	12925	12808	14941	14942	Continuing	Continuing

Mission Description and Justification: This project develops computer and communications technology options using commercial standard hardware and software to support mission planning and battlefield decision making. These efforts supports the Digital Battlefield Communications (DBC) advanced technology demonstration (ATD) via automated, real-time, digital information transfer, and the development and demonstration of communication systems needed for the Force XXI integrated digital battlefield. This project also supports the Tactical Command and Control Protect (TC2P) ATD by providing protection technologies for tactical internet command and control information systems, components and data, against modern network attacks. This project also performs development of on-the-move ultra-high frequency satellite communications technology, interfaces mobile ultra-high frequency satellite communications radios to combat net radio technology using commercial standard data packet protocols, and is developing multiband, multimode radio technologies as part of a Joint Service program with the Air Force and the Defense Advanced Research Projects Agency (DARPA).

FY 1998 Accomplishments:

- 2806 – Completed development of an integrated phased array antenna that can track multiple airborne relay systems from a mobile radio access point and allow robust on-the-move communications in support of the digital battlefield communications (DBC) advanced technology demonstration (ATD).
  – Conducted laboratory testing and evaluation of enhanced commercial terrestrial personal communication services (PCS) hardware for integration into the Army's warfighter information network proof of concept. Investigated and evaluated digital network radio technology to support the requirements for the Army's future digital radio.
  – Demonstrated narrow band, high frequency communications technology with tactical internet access.
  – Began development of an initial prototype of a photonically controlled phased array antenna to reduce size, weight and power requirements to meet future on-the move communications requirements.
  – Demonstrated on-the-move surrogate direct broadcast satellite (DBS) capability.
- 2675 - Designed and developed the Wideband Network Radio (WNR), WRN Testbed (WRNT), Software Development Environment (SDE), and the WRN.
  -Developed and delivered draft WRN architecture document, WRN system technical specifications and WRN waveform technical specifications.
  – Started development of WRN wideband waveform and protocols.
- 2061 – Integrated and demonstrated end-to-end super high frequency surrogate satellite communications capability for range extension. Began satellite communications terminal enhancements to reduce size and weight increasing throughput and mobility.
  – Developed unmanned aerial vehicle based battlefield-paging capability.

Total 7542

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603006A Command, Control and Communications Advanced Technology
	PROJECT 0247

FY 1999 Planned Program:

•	3036	– Develop and deliver all WRN products (WNR, WRNT, SDE, and WB waveform). – Test and evaluate new Joint Tactical Radio System (JTRS) WB waveforms, radios, and DARPA GloMo technology.
•	5132	– Demonstrate integrated DBC ATD technologies in support of high-capacity digitized communications and split-based operations. – Integrate and demonstrate enhanced commercial terrestrial PCS capability in the Army's warfighter information network proof of concept. – Demonstrate integrated phased array antenna to meet on-the-move radio access point communications requirements. – Develop photonically controlled phased array antenna to reduce size, weight and power requirements for on-the move communications technologies. - Demonstrate wideband high frequency communications technology, with access to the tactical internet, for transmitting maneuver and intelligence data from long range surveillance units that are beyond line of sight.
•	3942	– Demonstrate unmanned aerial vehicle based battlefield paging. – Fully integrate and demonstrate end-to-end unmanned aerial vehicle based surrogate communication (SHF) satellite capability, including ground component. – Demonstrate a surrogate for ultra high frequency (UHF) low earth orbit (LEO) multiple beyond line of sight communications (MUBLCOM) capability (leverages DARPA development). – Build and demonstrate airborne switching capability integrated with super high frequency surrogate satellite communication payload.
•	283	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	12393	

FY 2000 Planned Program:

•	4430	- Investigate and evaluate information protection technologies for the upper tactical internet with focus on network access protection, intrusion detection and host level protection.
•	3750	- Develop wideband power amplifier compatible with Joint Tactical Radio System (JTRS). - Integrate very high frequency (VHF)/ ultra high frequency (UHF) radio frequency (RF) receiver/transmitter multiplexer into single box. - Test and evaluate UHF multiplexer in an operational exercise.
•	1795	- Conduct an initial review of existing and proposed (LEO/ medium earth orbit (MEO)) wideband commercial satellite communication (SATCOM) technologies and capabilities. Initiate development of a fast recovery modem for extremely high frequency (EHF) on the move narrowband communication. - Demonstrate capability of joint tactical radio system (JTRS) compatible OTM antenna, and begin development of wider bandwidth OTM antenna. - Demonstrate performance increases possible using structure tuned antenna technology.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603006A Command, Control and Communications Advanced Technology PROJECT 0247

- 1425 - Complete fabrication and laboratory test of optically controlled phased array antenna.
  - Integrate system in shelter; test and demonstrate complete optically controlled phased array antenna systems.

Total 11400

FY 2001 Planned Program:

- 4535 -Investigate and evaluate information protection technologies for the upper tactical internet expanding the effort to address security management and malicious code detection and eradication. Integrate and test command and control protection solutions in a field environment.
- 3000 - Conduct test and evaluation of a wideband power amplifier.
  - Evaluate UHF MUX and wideband power amplifier prototypes through WRN testbed and field test.
- 2860 - Develop a fast recovery modem for Ka Band LEO/MEO on the move wideband communication .
  - Test and evaluate expanded (wideband) bandwidth JTRS compatible OTM antenna.

Total 10395

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603006A Command, Control and Communications Advanced Technology
	PROJECT D257

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D257 Digital Battlefield Communications	8092	4937	4749	4823	5787	5493	6519	6033	Continuing	Continuing

Mission Description and Justification: The objective of this Digital Battlefield Communications (DBC) advanced technology demonstration (ATD) project is to integrate communications hardware and software capable of providing seamless, multimedia communications for the digitized battlefield and to meet emerging requirements for high capacity, on-the-move information exchange. Force projection and evolving doctrine are expected to require significantly more communications bandwidth, drastically altered traffic patterns, new services (e.g. imagery), and higher mobility, especially at echelons brigade and below, than is currently supported by today's communications systems. This project will develop and demonstrate a series of products, through an evolutionary process, capable of transitioning into field units to support the future digitized brigade, division and corps. The project will build on early system performance models begun under the combined arms command and control program, in order to identify appropriate non-developmental wideband communications systems to supplement the data capacity of existing lower echelon networks. Once data "hot spots" and congestion points are identified in the existing architecture, warfighter demonstrations will be used to demonstrate the warfighter benefit of added capacity at key locations on the digitized battlefield, and to identify and size fieldable deployment packages consisting of wideband digital communications and support devices to supplement existing tactical communications systems. Technology demonstration units of wide-bandwidth digital radios will be required. Laboratory demonstrations and protocol development to permit asynchronous transfer mode traffic to interface with tactical radio/satellite equipment will be conducted. A mobile radio access point consisting of a high capacity, on-the-move trunk radio, powerful portable switch and legacy wide bandwidth digital subscriber networks will be developed and evaluated by troops in the field. The radio access point (RAP) will provide a high bandwidth on-the-move trunk feed in support of combat net radio, single channel radio access, and wideband data subscribers, all communicating on-the-move. Network planning tools and dynamic inter-network management schemes will be exploited for both pre-battle communications planning and dynamic reconfiguration during deployment. Development of on-the-move antennas begun in prior years will be extended to provide fieldable, low profile antennas better suited to on-the-move wideband needs to connect forward mobile elements in split based deployments. Wideband airborne communications relays will be developed and evaluated for warfighter utility in achieving range extension at high data rates. Commercial personal communication systems and direct broadcast satellite will be evaluated for possible tactical exploitation.

FY 1998 Accomplishments:

- 3231 – Completed development of the Digital Battlefield Communications (DBC) Advanced Technology Demonstration (ATD) radio access point prototype to demonstrate connectivity with the Army's warfighter information network proof of concept in a static environment.
  – Developed an integrated real time internet protocol (IP) with mobile IP for tactical multinet gateway ATM to support radio access point with low bit rate video teleconferencing.
- 2404 – Integrated and demonstrated dual band (X-band and Ku-band) airborne communications relay package capable of supporting 45 Mbps communications in support of DBC ATD.
  – Completed development of a high capacity trunk radio capable of operating at a data rate up to 45 Mbps while on the move.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603006A Command, Control and Communications Advanced Technology PROJECT D257

FY 1998 Accomplishments (continued):

– Completed development of a high capacity trunk radio capable of operating at a data rate up to 45 Mbps while on the move.

- 2457 – Conducted evaluation of the DBC ATD application and unique architectural needs to apply emerging commercial satellite personal communication services (PCS) technology to battlefield communications.
  – Completed laboratory integration of enhanced commercial terrestrial PCS hardware for integration into the Army's warfighter information proof of concept.
  – Demonstrated ATM benefits of a high bandwidth MSE backbone and interface ATM technology to the high capacity trunk radio in Division XXI.
  – Developed military-unique ATM enhancements (i.e. integrated voice, tactical adapter, forward error correction) to support operation in a tactical environment.
  – Conducted user tests of digital battlefield communications technologies in Division XXI and other user demonstrations. Provided technical/engineering and on-site field support for digital battlefield communications technologies in Division XXI.

Total 8092

FY 1999 Planned Program:

- 2894 – Demonstrate mobile radio access point. Integrate and demonstrate DBC ATD radio access point with on-the-move high capacity trunk radio and phased array antenna capable of mobile operation.
  – Integrate on-the-move, high capacity, trunk radio and mobile phased array antenna into the radio access point.
  – Develop, evaluate and demonstrate dual band airborne communications relay antenna improvements to provide consistent gain across the coverage area for improved range extension communications.
  – Demonstrate a dual band airborne communications relay package capable of supporting 45-Mbps communications
- 1956 – Integrate and demonstrate secure tactical PCS capability into the warfighter information proof of concept in support of the DBC ATD.
  – Insert and evaluate digital battlefield communications technologies in the Joint Warfighter Interoperability Demonstration.
  – Integrate and demonstrate enhanced ATM features into the radio access point and the Army's warfighter information proof of concept.
  – Demonstrate Army application of satellite PCS technology to provide a highly mobile, handheld, worldwide communications capability.
- 87 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 4937

FY 2000 Planned Program:

- 2014 - Extend existing communications testbed into a ground mobile testbed to provide an environment to demonstrate the concepts of mobile, seamless communications between the mobile trunking backbone communications and to the subscriber, lower data rate users.
  - Develop capability to enhance communications services to mobile, wireless tactical user such as voice, data, video, e-mail, file transfer, web browsing, video conferencing, etc.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603006A Command, Control and Communications Advanced Technology
	PROJECT D257

FY 2000 Planned Program: (continued)

- 2735 - Develop a multi-mode personal communications systems (PCS) handset prototype to facilitate the objective of one common handset for all user applications.
- Investigate and identify communications technologies to support distributed mobile wireless tactical operations centers.
- Identify and mature key technologies developed under the Defense Advanced Research Projects Agency (DARPA) Global Mobile program to support networked on-the-move communications.

Total 4749

FY 2001 Planned Program:

- 2073 - Integrate networking and link layer technologies for the future generation tactical internet into the ground mobile testbed.
- Explore methods to achieve guaranteed quality of service associated with real-time, internet protocol based, multimedia communications over tactical asynchronous transfer mode backbone networks.
- Enhance commercial personal communications technology currently being adapted to tactical applications to provide system elements that safeguard against inherent system vulnerabilities.
- Develop wireless LAN technology to provide fast Ethernet connectivity for mobile and ad-hoc networks where wired networks are inappropriate for existing infrastructures.
- 2750 - Integrate and demonstrate the matured DARPA Global Mobile program technology to support networked on-the-move communications. These technologies will be integrated into the ground mobile testbed.
- Integrate, demonstrate and evaluate communications technologies to support distributed mobile wireless tactical operations centers in the ground mobile testbed.
- Integrate enhanced communications services capability for mobile wireless tactical users into ground mobile testbed.
- Integrate multiple PCS waveforms into multi-mode PCS handset prototype.
- Integrate, evaluate and demonstrate key technologies developed under the DARPA Airborne Communications Node (ACN) program for extended range networked communications with the ground mobile testbed.

Total 4823

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603006A Command, Control and Communications Advanced Technology

PROJECT: D592

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D592 Space Applications Technology	2716	2443	4734	6290	4204	4303	4815	5297	Continuing	Continuing

Mission Description and Justification: The objective of this project is to optimize Army utilization of space based systems. The project involves: (a) space technology development and demonstrations for evaluating technology feasibility, determining Army utility, and refining requirements, and (b) space technology integration into battlefield operating systems. The project also addresses: defining Army requirements for space platforms; demonstrating advanced, compact space hardware; developing algorithms that optimally process space data; integrating satellite direct down link to ground systems; and providing an advanced technology base for the Army space exploitation demonstration program, the Tri-Service DoD space test program, and the exploitation of commercial space capabilities. The project focus is on space force enhancement (communications, intelligence, position/navigation, reconnaissance, surveillance, target acquisition, weather/terrain, missile warning) and space control (space surveillance) to improve warfighting capabilities and operations other than war.

FY 1998 Accomplishments:

- 642 – Developed design for unmanned aerial vehicle (UAV) and space based spectral overhead sensor technology with direct downlink capability.
- 1488 – Developed processing architecture for near real time processing of battlefield ordnance awareness data and collected key threat data.
- 586 – Demonstrated air to surface laser communications; assembled and tested prototype portable ground unit; integrated prototype portable ground unit into satellite to ground laser communications architecture.

Total 2716

FY 1999 Planned Program:

- 618 – Baseline sensor packaging and configuration for UAV and space applications with initial demonstration of on-focal plane array (FPA) processing of overhead sensor spectral data.
- 1336 – Develop an air platform battlefield ordnance awareness sensor design with onboard processing; develop algorithms.
- 436 – Demonstrate space to ground link and transition to Space and Missile Defense Battle Lab for laser communications tactical internet evaluation.
- 53 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2443

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603006A Command, Control and Communications Advanced Technology PROJECT D592

FY 2000 Planned Program:

•	1073	Demonstrate a hyperspectral overhead sensor with smart focal plane processing in the 1-2.5,3.5 and 8-12 micron wavebands; improve cueing and clutter rejection using polarization and on-FPA processing.
•	3166	Collect data in a variety of environments and develop targeting, identification, simultaneous events, and battlefield ordnance awareness software.
•	495	Develop phenomenology document and complete conceptual space surveillance design.
Total	4734	

FY 2001 Planned Program:

•	1105	Demonstrate on-chip neuromorphic processing and hyperspectral spatial and temporal signature processing for overhead sensor technology using airborne testing.
•	4205	Demonstrate near real time airborne battlefield ordnance awareness reporting; complete experimentation phase; define technical requirements for ordnance reporting; transition to the Space-Based Infrared System (SBIRS), National platforms, and the program executive office global combat service support (PEO-GCSS).
•	980	Complete development of threat database and assessment algorithms for space surveillance.
Total	6290	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603006A Command, Control and Communications Advanced Technology

PROJECT: D596

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D596 Field Laser Radar Demo	4661	0	0	0	0	0	0	0	0	9630

Mission Description and Justification: The objective of this Congressional special interest project was to provide data reduction and analysis of field experiments data to evaluate the utility of the Field Laser Radar for Army applications. The Field Laser Radar is an imaging, carbon dioxide (CO_2), laser radar (LADAR). This LADAR transmits a waveform capable of high-resolution measurements in both range and velocity. Potential applications that were investigated included theater ballistic missile defense and cruise missile defense. In addition, the equipment can provide long range, coherent remote sensing of chemical warfare agents.

FY 1998 Planned Program:

- 2500 – Completed chemical warfare agent detection experiments.
- 150 – Completed design and development for target mount.
- 1711 – Completed refinement of tracking and imaging algorithms.
- 200 – Completed development of discrimination algorithms.
- 100 – Completed chemical warfare agent detection experiments.

Total 4661

FY 1999 Planned Program: Program not funded in FY 1999

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603006A Command, Control and Communications Advanced Technology

PROJECT: D597

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D597 Wave Net Technology	1873	0	0	0	0	0	0	0	0	3844

Mission Description and Justification: The objective of this congressional special interest project was to develop and evaluate a Wave Net circuit to perform image compression and decompression. Wave Net is an application-specific integrated circuit that utilizes a neural network architecture to efficiently perform low loss image compression. Potential applications include compression of imagery for battlefield situation awareness, aerial surveillance sensor downlinks, and image based target hand-off.

FY 1998 Accomplishments:

- 1873 – Completed design, fabrication, and testing a Wave Net system to satisfy an Army video transmission objective utilizing previous year's prototype hardware and algorithm developments.
  – Completed demonstration and evaluation of Wave Net technology for combat vehicles, dismounted soldiers and commercial applications, and explored transition opportunities.

Total 1873

FY 1999 Planned Program: Program not funded in FY 1999

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603006A Command, Control and Communications Advanced Technology

PROJECT: D617

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D617 Global Broadcast System (GBS) Information Management	0	3974	0	0	0	0	0	0	0	3974

Mission Description and Justification: The objective of this one year Congressional special interest project is to develop, install and evaluate an operational prototype Global Broadcast Service/Information (IM) system for the Army First Digitized Division network architecture. This program specifically addresses joint service demonstrations coordinated through the joint directors of laboratories technology panel for C4, and provides key demonstrations of systems integration across the Army's battlefield functional areas. GBS/IM will provide efficient high data rate connectivity between many distributed information sources and warfighters who receive the broadcast directly on small, inexpensive user terminals. Broadcast data includes digitized imagery, logistics data, weather data, maps, operational orders (e.g., Air Tasking Order), and video. Phase One was started in 1996 and used commercial satellite leases to provide a CONUS-based testbed located at US Army CECOM for the Army TF XXI Army Warfighter Experiment (AWE) for requirements definition and operational concept refinement.

FY 1990 Accomplishments: Program not funded in FY 1998

FY 1999 Planned Program:

- 1279 - Complete evaluation of the DARPA BADD Phase 2 ACTD Information Dissemination Management (IDM) application and unique architecture needs to apply emerging Army Battle Command System information technology.
  - Complete demonstration of wide band, high-speed transmission of Map Files.
- 2590 - Complete the development of a Tactical IDM (T-IDM) System Architecture that establishes T-IDM as a "User Owned and Operated System".
  - Complete the development of a T-IDM Experimentation Plan and stand-up a Developmental Server in the CECOM Testbed and at the Ft Hood Central Test Facility.
- 105 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 3974

FY 2000 Planned Program: Program not funded in FY 2000.

FY 2001 Planned Program: Program not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603007A Manpower, Personnel and Training Advanced Technology

PROJECT: A792

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A792 Personnel Performance and Training	3913	2949	3030	3074	3123	3180	3786	4002	Continuing	Continuing

A. Mission Description and Justification: The objective of this program is to develop and demonstrate soldier-oriented technologies to enhance soldier and unit performance. The program is particularly responsive to CSA directed support for Training, Leader Development, and Soldier (TLS) issues related to digitization and Army After Next. The reduction of training and other personnel costs treats costs as an independent variable through the development of effective training strategies that incorporate appropriate mixes of live, virtual, and constructive simulations. Research 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-service, multi-site training, assessment, and feedback; and evaluating the effectiveness of a compressed gunnery training strategy for the Reserve Component. Research will demonstrate new methods for identifying high quality male and female enlistees, for assigning them to Military Occupational Specialties (MOS) that maximize total force readiness, and for retaining the most effective performers. It also will 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.

FY 1998 Accomplishments:

- 3913 - Assessed the effectiveness and efficiency of time-compressed tank gunnery training strategies for the Army National Guard to maximize training within resource limitations.
  - Completed guidelines for managing and sustaining the quality of structured, simulation-based training programs focused on the Close Combat Tactical Trainer (CCTT).
  - Assessed the overall current command climate in the Army.
  - Developed and pilot tested performance assessment measures for fire support training in joint environments.
  - Identified factors that facilitate effective Special Forces team performance.
  - Developed procedures for expert systems to diagnose strengths and weakness of armor platoons and provide feedback in After Action Reviews.
  - Produced algorithms for cognitive modeling and situation awareness behaviors for command entities in a computer-generated force.

Total 3913

FY 1999 Planned Program:

- 2907 - Develop prototype platoon and company team training support packages for Force XXI (digital) operations in the CCTT.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603007A Manpower, Personnel and Training Advanced Technology
	PROJECT A792

- Refine and expand applications of the prototype Commanders' Integrated Training Tool (CITT) for the CCTT and other simulation environments, including digital operations.

FY 1999 Planned Program: (continued)

- Develop and evaluate methods that assess unit command climate, and analyze trends related to soldier, training, quality of life and readiness issues.
-Process for transferring training and assessment techniques developed for the Special Forces to other conventional Army users.
- Assess the capability of the BeamHit small arms simulator to support rifle marksmanship training in the Reserve Component (RC).

• Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

42

Total 2949

FY 2000 Planned Program:

• 3030 - Develop and refine specific performance assessment tools for digital unit training in the CCTT and other simulation environments.
- Assess utility of Force XXI training packages, focusing on those produced by units through CITT and other available tools.
- Conduct annual assessment of Army command climate, identifying new issues of concern to soldiers and trends.
- Compare just-in-time to up-front training of procedural and cognitive skills to determine skill acquisition and retention effects.

Total 3030

FY 2001 Planned Program:

• 3074 - Develop and demonstrate new training and performance assessment technologies that prepare operators and commanders to take advantage of evolving digital systems.
- Conduct annual assessment of Army command climate, identifying new issues of concern to soldiers and trends.
- Determine if certain types of skills should be reacquired or sustained through training "just in time" or by means of job/performance aids.
- Refine and expand skill acquisition/decay model and guidelines based on research findings.
- Develop and evaluate strategy that reduces live fire engagements needed to support weapons qualification, addressing differences and similarities between Active Component and RC.

Total 3074

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603007A Manpower, Personnel and Training Advanced Technology

PROJECT: A792

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	2910	3021	3034	3044
Appropriated Value	3033	3021		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-93			
b. SBIR / STTR	-73	-42		
c. Omnibus or Other Above Threshold Reductions	-24			
d. Below Threshold Reprogramming				
e. Rescissions				
f. Transferred from USD(HA)	+1100			
Adjustments to Budget Years Since FY 1999 PB			-4	+30
Current Budget Submit (FY 2000 / 2001 PB)	3913	2949	3030	3074

Change Summary Explanation: Funding: FY98 – DoD Internal reprogramming moved Congressional special interest funds appropriated in the Defense Health Program to this PE for proper program execution (+1100).

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603105A Military Human Immunodeficiency Virus (HIV) Research

PROJECT: DH29

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DH29 Military HIV	17541	5672	5976	5926	5952	6098	6878	6901	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element supports research to provide concept exploration of candidate prevention vaccines to include safety and efficacy in model systems to prepare and conduct clinical studies. It funds Congressionally directed Acquired Immune Deficiency Syndrome (AIDS) research to control the infection in military environments, protect the military blood supply and protect military personnel from unusual risks associated with infection. AIDS research is focused on the following thrust areas: diagnosis, natural history, epidemiology, and vaccine development. Efforts are directed to answer militarily unique questions affecting manning, mobilization, and deployment. This program is managed primarily by the U.S. Army Medical Research and Materiel Command. The major contractor is the Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, MD. Additional AIDS related research is conducted within the following projects: 0601102A, project S17; 0602787A, project 873; 0603105A, project H29; 0603807A, project 811; and 0604807A, project 812.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	2629	5710	5651	5548
Appropriated Value	2713	5710		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-84	-38		
b. SBIR / STTR	-66			
c. Omnibus or Other Above Threshold Adjustments	14978			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			325	378
Current Budget Submit (FY 2000/2001 PB)	17541	5672	5976	5926

Change Summary Explanation: Funding: FY 1998: Congressional special interest funding reprogrammed by DoD to this PE for proper program execution.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603105A Military Human Immunodeficiency Virus (HIV) Research
	PROJECT DH29

FY 1998 Accomplishments:

- 17541 Began Phase 1/2 clinical trial of a bivalent subtypes B & E human immunodeficiency virus (HIV) recombinant gp120 vaccine in Thailand; successfully enrolled 380 subjects (12 in open portion, 368 in blinded portion of study; study is ongoing. Demonstrated safety in 12 open study volunteers and induction of binding antibody to both subtypes B & E after the third immunization. Analysis of safety and immunogenicity data for the blinded portion of the trial will be completed at the end of the study. Began a Phase 1 clinical trial in U.S. volunteers of oligomeric gp160 vaccine alone or after priming with a live canarypox vector. Successfully vaccinated 29 subjects; no serious adverse events have been reported. Final data analysis awaits study completion. Developed protocols for gene-chip detection of HIV drug resistance that permit consistently accurate detection of drug-resistant isolates at viral loads of less than 2,500 copies/ml, necessary for accurately studying and understanding the implications of breakthrough viremia in HIV-infected patients and for devising clinically relevant protocols for deployment and use of expensive new technology for clinical management of HIV patients. Validated that the performance of newly available gene-chip technology in the detection of HIV drug resistance is equal to that of more traditional sequencing efforts which are time-consuming and more costly. Demonstrated that existing gene-chip technology is unable to accurately detect gene mutations in non-subtype B HIV isolates. Began efforts to alter the composition of the gene-chip to permit analysis of all subtypes of HIV, important for management of soldiers and others with non-subtype B infection. In continuing surveillance and epidemiologic studies, obtained the first full length genome sequences of subtype F from brazil, Kenya and Zaire and obtained full-length genomes for two new strains of subtype A from Djibouti. These studies are important for continued disease risk assessment and for design of candidate preventive vaccines. Established a panel of 200 sera representing all subtypes of HIV-1 which have been accurately genotype by multiple methods, a necessary tool in the effort to develop a serological assay that can accurately discriminate subtypes of HIV-1, eventually useful to field surveillance and epidemiological studies. Began a study to determine the subtype of all new infections with HIV that occur in U.S. military personnel, important for documenting global dispersal of HIV subtypes and for determining and designing vaccines for prevention of infection among U.S. forces. Began a study to determine the temporal trends of non-subtype B infection in the U.S. using HIV postive sera (unlinked to any identifiers) obtained during the past 14 years from recruit screening programs. Demonstrated that the molecular epidemiology of new HIV infections in Nigeria reflects that the majority of new infections consist of HIV hybrid subtypes (subtype G/A), raising the likelihood that evermore complex strains of HIV may occur. This effort is important for understanding and defining disease risk assessment for U.S. forces deployed in such regions and for design of preventive candidate vaccines. Demonstrated that the genetic diversity of HIV-1 in Thailand has increased since 1990 when HIV was first isolated and sequenced, important for understanding and defining virological and immunological events in vaccine trials and for the design of vaccines for prevention of HIV infection. Standardized multiple assays for subtype E HIV-1, including neutralization assay, cytotoxic T lymphocyte assay, lymphoproliferation assay, and viral culture. This effort is important for evaluation of vaccine-induced immune response in clinical vaccine trials in Thailand. Began a seroconvertor study to identify and evaluate all new infections with HIV-1 among military healthcare beneficiaries to document risk behaviors associated with HIV infection among military service members; to design prevention interventions; and to document and define the extent of non-subtype B infection and viral drug resistance among military service members. Enrolled 263 subjects in the first year of study and documented non-subtype B infection in 10 of 208 subjects (7 subtype E). Documented that 20% of subjects with new HIV infection have a drug-resistant strain.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603105A Military Human Immunodeficiency Virus (HIV) Research
	PROJECT DH29

FY 1998 Accomplishments: (continued)

Demonstrated that immunization with recombinant gp160 had no benefit for subjects already infected with HIV-1. Demonstrated that re-infusion of *ex vivo* expanded autologous CD4 lymphocytes into HIV infected patients is safe and resulted in raising of measured CD4 lymphocyte counts and normalization CD4/CD8 ratios. This may offer additional treatment options for infected patients. Additional studies are necessary to understand long-term clinical implications and long-term fate and function of re-infused cells. Demonstrated that a targeted behavioral intervention program [STD/HIV Intervention Program (SHIP)] can significantly decrease self-reported risk behaviors for HIV-1 infection. Transitioned the SHIP intervention to the Marine Security Guard School and the Navy Preventive Medicine Technician School. Began a cohort feasibility study at a family planning clinic in Thailand to prepare for future Phase 3 vaccine trials of preventive HIV vaccines in Thailand. Reached target enrollment of 1,008 subjects within 5 months of study implementation.

Total 17541

FY 1999 Planned Program:

- 5521 Establish laboratory infrastructure in Thailand for support of efficacy vaccine trial. Conduct Phase 1/0 study of DNA vaccine candidate in the U.S. Transition to advanced development a candidate bivalent vaccine with potential to prevent HIV infection in 70 percent of immunized personnel. Conduct Phase 0/1 study of avipox-vectored gp160 vaccine in Thailand. Complete Phase 1/2 study of bivalent gp120 vaccine in Thailand.
- 151 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 5672

FY 2000 Planned Program:

- 5976 Define the correlates of immunity to HIV, necessary for vaccine design. Establish genetic and phenotypic correlates of drug resistance among HIV-1 clinical isolates, necessary for establishing drug treatment strategies for military dependents. Evaluate and validate a rapid test for field diagnosis of HIV infection. Conduct clinical studies to slow progression and prevent immune deficiency related to HIV infection. Develop a vaccine process to prevent HIV infection of all genotypes of HIV-1. Define the correlates of immunity to HIV. Establish the genetic and phenotypic correlates of drug resistance as a clinical tool.

Total 5976

FY 2001 Planned Program:

- 5926 Transition to advanced development a test for simple and rapid forward diagnosis of HIV infection. Conduct Phase 0/1 study of novel vaccine vector for the prevention of HIV-1. Conduct Phase 0/1 study of oligomeric protein vaccines. Clinical evaluation of novel methodologies for detection antiretroviral drug resistance.

Total 5926

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	12174	9907	24618	21434	19462	15168	13047	12900	Continuing	Continuing
D177 Joint Air/Land/Sea Precision Strike Demonstration	10049	9457	24618	21434	19462	15168	13047	12900	Continuing	Continuing
D546 Synthetic Aperture Radar Target Recognition and Location System	2125	450	0	0	0	0	0	0	0	12595

A. Mission Description and Budget Item Justification: Overall Joint Precision Strike Demonstration (JPSD) program goals are to reduce sensor-to-shooter timelines from hours to minutes as well as to achieve quantifiable improvements in target location and identification, weapons systems responsiveness and kill capability, and accurate damage assessment through such techniques as near-real-time sensor cueing, near-real-time data dissemination, seamless sensor-to-shooter node communication, dynamic re-targeting, improved weapons system accuracy and precision guided munitions. This program provides for the integration of new, high-payoff technologies, architectural and operational concepts, along with existing and emerging systems to demonstrate enhanced precision strike and counterfire capabilities for targets at deep and extended ranges. The JPSD objectives are: to locate, identify, and kill high-value, time-critical targets and to assess damage within tactically meaningful timelines. The program conducts building block demonstrations to identify technical and operational barriers to an adverse weather, day/night, end-to-end, sensor-to-shooter precision strike capability and to demonstrate and experiment with potential solutions to these barriers. This program element also funds development/experiment activities for the Synthetic Aperture Radar Target Recognition and Location System (STARLOS) real-time Aided Target Recognition (AiTR) technology. The work in this program element is closely coordinated with the Joint Staff, other services, the Army's combat development community, TRADOC Battle Labs, and appropriate materiel developers to conduct field demonstrations and experiments to assess specific technologies for military needs. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan, the Army Modernization Plan, and the Joint Warfare Science and Technology Plan. The work also supports Division XXI and the Army Warfighting Experiments (AWEs).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	12773	9973	19003	22383
Appropriated Value	13664	9973		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-977	-66		
b. SBIR / STTR	-313			
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming	-200			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			5615	-949
Current Budget Submit (FY 2000/ 2001 PB)	12174	9907	24618	21434

Change Summary Explanation: FY00 Plus up supports the Joint Intelligence Surveillance Reconnaissance (JISR) Technology Demonstration Program, the Joint Continuous Strike Environment (JCSE) ACTD and upgrade current capabilities to the Joint Integration and Evaluation Center (JIEC) at Fort Belvoir.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603238A Air Defense/Precision Strike Technology PROJECT D177

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D177 Joint Air/Land/Sea Precision Strike Demonstration	10049	9457	24618	21434	19462	15168	13047	12900	Continuing	Continuing

Mission Description and Justification: Through a series of building block demonstrations, the Joint Air Land Sea Precision Strike (JT ALS PS) Demonstration Project has identified barriers to an advanced precision strike capability and assessed candidate solutions to these barriers. The FY95-FY96 Precision/Rapid Counter Multiple Rocket Launcher (P/RC-MRL) Advanced Concept Technology Demonstration (ACTD) was conducted with highly successful demonstrations in September 1995 at Fort Hood, TX, and in September/October 1996 in Korea. The P/RC-MRL ACTD provided U.S. Forces Korea (USFK) with a significantly enhanced capability to locate, track, and defeat the North Korean 240mm MRL threat by delivering and demonstrating Leave Behind prototype systems that include: connectivity between the Korean Combat Operations Information Center and the 2nd Infantry Division (2ID); enhancements to the Firefinder radar system; automation for the 2ID Main Command Post; enhancements of Army connectivity to Air Force and Navy command and control systems to provide a joint solution to the 240mm MRL threat; and Aided Target Recognition (AiTR) capability for the Tactical Endurance Synthetic Aperture Radar (TESAR) sensor on the Predator Unmanned Aerial Vehicle (UAV). The Commander in Chief, United Nations Command (CINCUNC) requested that the successful methodologies for solving critical precision strike issues be applied at theater level. In response, the concept for a Theater Precision Strike Operations (TPSO) ACTD was formulated in FY97 and formal program approval was achieved in FY98. TPSO is designed to provide a significantly enhanced joint and combined capability for the CINC to plan and conduct Theater Counterfire and Precision Strike Engagements through the real time synchronization of US/Coalition assets. Technologies to provide an improved Joint capability in these areas are demonstrated under this project beginning in FY98, to support the needs of the CINCUSNC and to serve as the Army's contribution to joint technology and digitization. Efforts in this project are managed by the Director, Joint Precision Strike Demonstration Project Office, Fort Belvoir, VA, Program Executive Officer, Intelligence, Electronic Warfare, and Sensors (PEO-IEW&S), Fort Monmouth, NJ. The Prime contractor is Raytheon, Bedford, MA.

FY 1998 Accomplishments:

- 4820 - Completed the transition and functionalities of P/RC-MRL ACTD leave behinds to 2ID and Army fielded systems, respectively.
  - Structured leave behind systems support for the P/RC-MRL ACTD.
  - Published a finalized comprehensive lessons learned P/RC-MRL ACTD report.
  - Ascertained P/RC-MRL product applicability to other Army/Joint Precision Strike requirements.
  - Defined technical growth areas for continued integration of Integration and Evaluation Center (IEC) capabilities.
  - Conducted a highly successful flight demonstration of the Reconnaissance, Infrared, Surveillance, Target Acquisition 2nd Generation (RISTA) II sensor on a UAV.
- 5229 - For the TPSO ACTD, identified and prioritized warfighter requirements to be developed in software enhancements. Assessed functionality resident in current Army baseline systems and in coordination with responsible PEOs, refined lists of functions to be completed, accelerated and added to future versions of software. Staffed TPSO ACTD Management Plan and received approval.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603238A Air Defense/Precision Strike Technology PROJECT D177

FY1998 Accomplishments (Continued)

- Coordinated and improved the rapid software prototyping capabilities and network connectivity with the Central Tech Support Facility (CTSF), Fort Hood, TX, Depth and Simultaneous Attack Battle Lab (D&SABL), Fort Sill, OK, and the Integration & Evaluation Center (IEC) at Fort Belvoir.
- Initiated joint cooperative software development and integration efforts with the United States Air Force, United States Navy, and United States Marine Corps necessary to support synchronized Joint/Combined deep operations planning and precision strike operations. Acquired the necessary HW/SW to replicate a "joint lab" environment from which integration efforts will be conducted.

Total 10049

FY 1999 Planned Program:

- 9213 - Participate in Commander-in Chief United Nations Command (CINCUNC) warfighting exercises, Reception Staging Onward Movement & Integration (RSOM&I), Foal Eagle, Summer-Ex and Ulchi Focus Lens (UFL), documenting warfighting functional requirements and integrating emerging technologies/capabilities for the Theater Precision Strike Operations (TPSO) ACTD.
- Provide CINCUNC with enhanced technical command and control capabilities for conduct of synchronized Joint/Combined deep operations and precision strikes for TPSO.
- Execute the rapid prototyping capabilities at the IEC at Fort Belvoir, the CTSF at Fort Hood, TX and D&SABL at Fort Sill, OK.
- Expand the Joint Precision Strike Demonstration threat database to integrate joint systems into the simulation environment required supporting TPSO evaluations.
- Refine the IEC analytical capability to measure performance and effectiveness so those objective conclusions can be made regarding the military utility of the demonstrated technologies and concepts.
- Conduct technical reviews and demonstrations to assess the contribution of emerging technologies to TPSO.
- Plan the FY99 baseline scenario exercise and assess the communications infrastructure necessary to conduct the demonstration.
- Transition to a High Level Architecture (HLA) environment that supports simulating Man in the Loop (MITL) for FY00 demonstration.

244 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9457

FY 2000 Planned Program:

- 18102 - Participate in Commander-in- Chief United Nations Command (CINCUNC) warfighting exercises to document functional requirements supporting pre-prototype design and integration objectives for the Theater Precision Strike Operations (TPSO) ACTD.
- Plan and execute a simulation stimulated demonstration, employing an unreinforced Korean scenario, in which United States Forces Korea (USFK) soldiers (Man-in-the-Loop) in the Ground Component Commander Deep Operations Coordination Center (GCC DOCC) will operate pre-prototype developmental systems, derived from baseline Command, Control, Communication, Computers and Intelligence (C4I) acquisition programs, as an early user evaluation and proof of concept in a realistic warfighting environment. Demonstration will include Republic of Korea (ROK) observation in preparation for ROK participation in the planned FY 01 Demonstration.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603238A Air Defense/Precision Strike Technology PROJECT D177

FY 2000 Planned Program: (continued)

- Conduct rapid prototyping operations at the Joint Integration & Evaluation Center (JIEC), Fort Belvoir, in conjunction with the Central Technical Support Facility (CSTF), the Depth & Simultaneous Battle Lab (D&SBL), Battle Command Battle Lab-Huachuca, as well as Air Force, Navy and Marine Corps activities, to develop pre-prototype systems, designed to facilitate the coordination planning and synchronization of joint and combined forces.
- Expand, upgrade and implement the High Level Architecture (HLA) environment and automated Data Collection Architecture, that will stimulate the FY 00 and FY 01 Man-in-the-Loop (MITL) demonstrations, and provide the data collection capability required to make credible warfighting assessments.
- Conduct technical reviews to assess the warfighting effectiveness of the emerging technologies integrated into the pre-prototype systems under development,

1000	- Validate and coordinate Joint Continuous Strike Environment (JCSE) requirements in targeting Time Sensitive Surface Targets. Participate in Battlefield Maritime Experiment.
1500	- Expand Analytical capability for Joint Integration and Evaluation Center (JIEC): (1) Provide additional connectivity to TRADOC Battle Labs and Joint Battle Center (JBC) to expand on current connectivities with Army, Air Force and Navy Battle Labs. Provides enhanced Joint user/developer testbed for rapid prototyping of new systems; and (2) Support analytical trade-offs for the Strike Force Technology Options.
4016	- Define Joint Intelligence Surveillance Reconnaissance (JISR) technology demonstration program. Define data collection architecture. Design and begin integration of JISR family of models, and JISR testbed as part of the JIEC.
Total 24618	

FY 2001 Planned Program:

• 21209	- Participate in CINCUNC warfighting exercises to refine the functionality of pre-prototype systems demonstrated during the FY 00 Demonstration. - Plan and execute a simulation stimulated demonstration, employing a scenario representative of the transition from an unreinforced Korean Theater to a reinforced Korean Theater. Both ROK and U.S. forces, including the III U.S. Corps, will participate in a MITL fashion both in the GCC DOCC and at the critical external nodes. They will operate the objective, residual capability candidate systems developed during the TPSO ACTD in a realistic warfighting environment. - Conduct rapid prototyping operations at the IEC, Fort Belvoir, in conjunction with the CTSF, the D&SABL, as well as the Air Force, Navy and Marine Corps activities, to refine the functionality and improve the capability of the pre-prototype systems evaluated during the FY 00 Demonstration. - Conduct technical reviews to assess the warfighting value added contributed by each pre-prototype, residual capability, candidate systems during the demonstration, and determine which candidate systems exhibit sufficient maturity and capability to warrant qualification as an ACTD “Leave Behind”. - Develop transition and sustainment plans to support the “Leave Behind” Systems during the period of interim capability (FY 02-03).
225	- Evaluate and validate the value added of Joint Continuous Strike Environment (JCSE) system integration.
Total 21434	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology

PROJECT: D546

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D546 Synthetic Aperture Radar Target Recognition and Location System	2125	450	0	0	0	0	0	0	0	12595

Mission Description and Justification: This project demonstrates the feasibility of locating and identifying high value targets from an Army designated aerial platform. The focus of the program is on Aided Target Recognition (AiTR) of short-range ballistic missiles, surface-to-air missile launchers, rocket launchers and other designated military targets of interest. The targets are located with airborne sensors and identified with a real-time AiTR system. In FY 97, the Synthetic Aperture Radar Target Recognition and Location System (STARLOS) AiTR effort for the Joint Precision Strike Demonstration (JPSD) Precision/Rapid counter Multiple Rocker Launcher (MRL) Advanced Concept Technology Demonstration (ACTD) was completed. This AiTR capability was successfully integrated in a ground control station and was successfully demonstrated against the North Korean 240 MRL threat. The STARLOS program is now actively involved in the adaptation of the STARLOS technology with the next generation sensors being procured for the Tactical Unmanned Aerial Vehicle (TUAV) program. The program direction is to utilize STARLOS technology to provide AiTR aids and processing capabilities that will enhance the Human Machine Interface and will alleviate the analytic requirements of the TUAV operator. This program is managed by Program Executive Officer-Intelligence, Electronic Warfare & Sensors, PM Tactical Endurance Synthetic Aperture Radar, with matrix support from Army Research Laboratory, Adelphi, MD and Night Vision and Electronic Sensors Directorate, Communications and Electronics Command (CECOM) Research & Development Engineering Center (RDEC), Fort Monmouth, NJ.

FY 1998: Accomplishments:

- 1219 - Adapted and integrated AiTR capabilities into the Multi-Sensor Testbed (MSTB) system for experiments/demonstrations with the Training & Doctrine Command Systems Manager Unmanned Aerial Vehicle (TSM UAV) and Battle Command Battle Lab (Fort Huachuca).

325 - Upgraded MSTB and conducted data collection on a TUAV scenario target set.

450 - Conducted experiment and demonstration with TSM UAV and Battle Labs on the incorporation of the AiTR capability into the TUAV system.

131 - Investigated approaches on how to integrate AiTR technology with upcoming TUAV subsystems, i.e. the Multi-Mission Common Modular Unmanned Aerial Vehicle (UAV) Sensors Advanced Technology Demonstration (ATD) ((SAR & Electro Optical Infrared (EO/IR) Sensors)), the Tactical Control Station, the Data Link Programs and the TUAV platform.

Total 2125

FY 1999 Planned Program:

- 438 - Continue the investigation on the utilization of a Common Aided Target Recognition (AiTR) capability and continue technical reviews with the Training & Doctrine Command Systems Manager Unmanned Aerial Vehicle (TSM UAV) and Battle Command Battle Lab (Fort Huachuca) on the incorporation of an AiTR solution for the Multi-Mission Common Modular Unmanned Aerial Vehicle (UAV) Sensors.

12 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs..

Total 450

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603238A Air Defense/Precision Strike Technology PROJECT D546

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270A Electronic Warfare (EW) Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	7672	11425	16169	17008	15398	17110	19426	20409	Continuing	Continuing
DK15 Advanced Communications Electronics Countermeasures Demonstration	2701	2810	6893	6917	8096	9104	10848	11408	Continuing	Continuing
DK16 Non-Communications Electronic Countermeasures Technology Demonstration	4971	8615	9276	10091	7302	8006	8578	9001	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element funds two projects that provide technology options for current and future electronic warfare (EW) systems. The Advanced Communications Electronics Countermeasures Demonstration (DK15) provides technology demonstrations in communications countermeasures (CM), information collection and reporting for transition to Army intelligence, and electronic warfare (IEW) systems through the block improvement process. The effective use of specific components, software and hardware for multiple applications will enable the Army to collect intelligence from modern modulation threat electronic systems in order to disrupt their operation, denying the enemy use of their command, control and communication (C3) assets. This project also supports demonstrations of automatic fusion of intelligence data from multiple sources. Non-Communications Electronic Countermeasures Technology Demonstration (DK16) demonstrates the feasibility and effectiveness of non-communications electronic warfare countermeasures and electronic support/electronic intelligence (ES/ELINT) for self protection from radar, electro-optical, and infrared guided anti-aircraft artillery, surface-to-air missiles, artillery, and top attack weapons, and provides precise targeting information on non-communications emitters. Area protection technology from radar threats is also developed. Work in these projects will lead to technology applications that will significantly contribute to winning the battlefield information war by controlling the electromagnetic spectrum. Work in this program element (PE) supports the multispectral countermeasures advanced technology demonstration, Integrated situation awareness and targeting ATD, the Integrated Countermeasures (ICM) technology demonstration and provides component technology for the hit avoidance technology demonstration. Work in this program element adheres to tri-service Reliance agreements on electronic warfare. Work in this program element is related to and fully coordinated with efforts in PE 0602270A (Electronic Warfare Technology), and various Navy and Air Force program elements in accordance with the on-going Reliance joint planning process. Navy developments are conducted in PEs 0604755N (Ship Self Defense), 0204575N (Electronic Warfare Support), and 0604573N (Shipboard Electronic Warfare Improvements). Air Force developments are conducted in PEs 0604738F (Protective Systems), 0604793F (Tactical Protective Systems) and 0604710F (Reconnaissance Electronics Warfare Systems). Coordination is effected between the Services and Defense Advanced Research Projects Agency (DARPA) to eliminate duplication of effort and ensure the interchange of technical data.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270A Electronic Warfare (EW) Technology

B. Program Change Summary:	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	7929	11508	16744	18118
Appropriated Value	8182	11508		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-253	-83		
b. SBIR / STTR	-193			
c. Omnibus or Other Above Threshold Reductions	-64			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-575	-1110
Current Budget Submit (FY 2000 PB)	7672	11425	16169	17008

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270A Electronic Warfare (EW) Technology

PROJECT: DK15

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DK15 Advanced Communications Electronics Countermeasures Demonstration	2701	2810	6893	6917	8096	9104	10848	11408	Continuing	Continuing

Mission Description and Justification: This project demonstrates technology in support of the Army's concept for Force XXI intelligence operations. Communications counter measure and counter-counter measure technologies are demonstrated to provide information warfare and information operations capabilities to intercept, identify, locate and manipulate threat computer networks and their components. Electronic attack products provide the capability to disrupt, deny, degrade or destroy enemy threat computer networks or information resident in those networks. Knowledge gained from demonstration and testing of these technologies and techniques is used to assess vulnerabilities of friendly systems and to develop protection capabilities. In addition, data fusion techniques are being integrated and transitioned to program managers to demonstrate a joint intelligence, surveillance, and reconnaissance product for brigade level and below. Data from traditional intelligence sensors and from non-traditional sources will be integrated to provide situational awareness of red and blue forces. Unmanned aerial vehicle (UAV) payloads employing sensor cross-cueing for rapid target detection and identification will be tested and evaluated. User friendly tools and visualization technology will be demonstrated to provide quality data in a timely manner to enable friendly commanders to operate effectively within the decision cycle of threat commanders. This project focuses on testing, evaluating, and integrating specific information warfare and information operations components, hardware, and software to provide flexible, modern systems and upgrades to existing systems to achieve information dominance, protect the force, and shape the battlespace.

FY 1998 Accomplishments:

- 1290 – Performed field evaluation/demonstration of jamming techniques against modern communication signals.
  – Integrated and validated hardware/software solutions to the Tactical Internet addressing exploitable vulnerabilities.
- 846 – Demonstrated a wide bandwidth signal intelligence (SIGINT) electronic support (ES) package on a UAV platform. The ES package successfully detected, intercepted, and relayed radio frequency (RF) signals to existing SIGINT equipment for processing, thereby extending the range of existing SIGINT assets.
- 565 – Successfully demonstrated enhanced operator planning and sensor management tool at Task Force XXI Advanced Warfighting Experiment. Results indicate decreased time for initial placement and redeployment of electronic sensors and electronic attack systems. Tool effectively placed assets to target red forces without disrupting friendly assets.
  – Completed SIGINT/moving target indicator (MTI) prototype and demonstrated its sensor cueing capability during limited unit training for Force XXI Battle Command Brigade and Below (FBCB2).
  – Tested algorithms to extract terrain features from the National Imagery and Mapping Agency (NIMA) product for improved visualization tools.

Total 2701

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270A Electronic Warfare (EW) Technology
PROJECT DK15	

FY 1999 Planned Program:

- 2030 – Conduct demonstration against modern communication signals using the field programmable gate array analysis/control system.
  – Perform laboratory and field evaluation of capabilities against more complex modern communication signals.
  – Evaluate command and control attack capabilities against existing security architecture and participate in Initial Operational Test and Evaluation for First Digitized Division.
  – Evaluate SIGINT payloads for UAVs.
  – Transition Electronic Support/Electronic Attack techniques to information warfare system.
- 723 – Demonstrate and evaluate, through simulation, an automatic target tracking capability based on combined airborne survivability equipment/MTI.
  – Upgrade operator planning and sensor management tool to integrate air and ground based capabilities. Begin transition to GUARDRAIL system.
  – Evaluate effectiveness of integrating various traditional and non-traditional sensor products to enhance intelligence, surveillance and reconnaissance (ISR) at the Brigade level.
- 57 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2810

FY 2000 Planned Program:

- 1800 – Integrate SIGINT/MTI sensor cross-cueing and situation displays into the common ground station and all source analysis system. Complete transition of operator planning tool to GUARDRAIL.
  – Designate system architecture and begin prototyping for joint ISR technology demonstration. Identify joint experiments.
- 800 – Prototype UAV payload for sensor cross-cueing to decrease the time required to locate, image, and identify target emitters over a wide area.
  – Integrate technology to provide intelligence collection, counter measures, and counter-counter measures capabilities for tactical units to enable interception, identification, and geolocation of threat emitters in the presence of decoys, deception, and jamming.
- 4293 – Demonstrate capability to develop and launch both RF and wired-based attacks against Army information systems as a tool to validate protection mechanisms.
  – Perform interactive testing / validation of Army command and control protection systems against developed attacks.
  – Conduct vulnerability assessment to evaluate level of security achieved /tool suitability based on test results.
  – Iteratively revise protect/attack tools to counter newly identified threats.

Total 6893

FY 2001 Planned Program:

- 1200 – Test and evaluate initial prototype providing joint ISR capability at the brigade level.
- 375 – Integrate ultra-low sidelobe antenna, adaptive power control, and specific emitter identification technology for advanced intelligence collection and countermeasure modular building blocks and prototype air-droppable programmable jammer UAV payload.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270A Electronic Warfare (EW) Technology
	PROJECT DK15

- 1242 – Provide an information operation capability to search for, intercept, identify, locate and manipulate computer networks and their components to detect and recognize threat computers and information resident in those computers.

FY 2001 Planned Program: (continued)

– Provide an information operation capability to disrupt, deny, degrade or destroy information resident in threat computers or computer networks or the computers and networks themselves.

- 4100 – Leverage results of interactive testing of command and control protection systems to develop attack applications to disrupt/deny threat information systems.

– Design and conduct distributed simulation experiments to support development efforts and training for integrated command and control protect and attack capabilities, culminating in a field test for the Digitized Division by FY02. Provide results/recommendations to Program Executive Officer C3S and Program Executive Officer IEW and jointly develop a transition and integration plan.

Total 6917

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603270A Electronic Warfare (EW) Technology

PROJECT: DK16

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DK16 Non-Communications Electronic Countermeasures Technology Demonstration	4971	8615	9276	10091	7302	8006	8578	9001	Continuing	Continuing

Mission Description and Justification: This program demonstrates the feasibility and effectiveness of non-communication electronic warfare hardware and software countermeasure technologies for aircraft, ground vehicles, and the dismounted soldier. This provides self-protection against radar, optical, electro-optical and infrared (IR) threats. The multispectral countermeasures advanced technology demonstration provides technology options for product improvements to the suite of integrated infrared countermeasures/common missile warning system (SIIRCM/CMWS), which provides the primary protection to Army helicopters against infrared seeker missiles. Integrated multispectral radar and infrared countermeasures will be demonstrated to provide present and future Army aircraft with full spectrum protection against advanced missiles and integrated air defense systems that can near simultaneously direct radar and infrared homing missiles and fuzed anti-aircraft artillery fire. Integrated Situation Awareness and Targeting (ISAT) ATD and Integrated Countermeasures (ICM) technology demonstration will demonstrate an integrated multispectral suite of precision warning sensors that will provide Army aviation and ground vehicles with full dimensional protection, and demonstrate a "non-traditional " use of electronic combat systems to provide precision targeting, combat identification, and real time situation awareness updates to other aircraft, ground vehicles, and command and intelligence fusion centers.

FY 1998 Accomplishments:

- 4971 – Completed testing of multispectral countermeasures advanced technology demonstration component modules that will demonstrate technology upgrades for the suite of integrated infrared countermeasures/common missile warning system (SIIRCM/CMWS).
  – Completed integration of solid state, mid infrared laser that will replace neon arc lamp technology in the external jamming pod and provide a significant improvement in jamming output power, and reduce weight, mechanical complexity, and cost.
  – Conducted integration of mid-infrared fiber optic cable that will replace a mechanical, articulated arm used to transmit laser energy from on-board laser module to the external laser jamming pod, and provide a significant improvement in laser beam quality, and reduce weight, mechanical complexity, maintenance requirements, and cost.
  – Collected missile signature data to support improved detection algorithm developments.
  – Developed warning techniques to counter far-IR laser beam rider missiles and munitions, continue research to obtain effective countermeasures.

Total 4971

FY 1999 Planned Program:

- 6838 – Complete integration and survivability integration lab testing of the multispectral countermeasures advanced technology demonstration test bed.
  – Complete aircraft integration and conduct live fire cable car tests to demonstrate the new capability to jam and defeat advanced pseudo imaging and imaging surface to air missiles (SAM).

– Demonstrate detection and countermeasures against multi-purpose guided missiles that can engage both rotary wing aircraft and ground vehicles.

FY 1999 Planned Program: (continued)

– Transition alternative laser technologies, jamming waveforms, fiber optic cable and missile detection algorithms as technology options for SIIRCM product improvement.

- 970 – Develop requirements and design architecture for integrated situation awareness and targeting advanced technology demonstration that will demonstrate multispectral threat warning, geo-location, emitter identification, and situation awareness technology upgrades to the suite of integrated RF countermeasures.
  – Develop modular sensor to detect and locate laser designated and laser beamrider missiles, and provide information used to select and optimize the appropriate countermeasure response.
- 600 – Integrate digital and hardware-in-the-loop jamming effects models of advanced IR SAMs, anti tank guided missiles (ATGMs) and RF SAM systems into the survivability integration lab to support demonstration of integrated countermeasures technologies.
- 207 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 8615

FY 2000 Planned Program:

- 7876 – Conduct distributed interactive simulations with aviation and ground users to refine integrated sensors and targeting functional modes and operator interfaces.
  – Test and evaluate multi-wavelength missile warning sensor technologies that will provide extended range detection of missile launches, reduce false alarms, and provide sufficient signature data to allow discrimination of anti-tank from anti-aircraft missiles.
  – Complete development and testing of laser warning receiver module that provides the capability to locate and discriminate between laser designators and laser beam directors.
  – Identify communication links, and define variable message format requirements needed to transmit spot reports of missile launch, laser designator/beam director, and radar locations and emitter identification data from aircraft to ground vehicles and command/intelligence fusion centers.
  – Test and evaluate new time difference of arrival techniques to precisely locate surveillance and targeting air defense radars. (Joint with Naval Research Laboratory)
  – Test and evaluate algorithms/software for correlating missile warning data and digital terrain elevation data to provide geolocation of missile launch locations.
- 1400 – Develop and conduct hardware-in-the-loop tests of an advanced coherent RF jammer modulator/transmitter to defeat coherent phased array radars and anti-aircraft artillery employing RF fuzes.
  – Develop and evaluate special RF countermeasures techniques that further reduce the detectability of reduced cross section aircraft.
  – Develop and evaluate techniques to counter a new generation of IR tracked, command-to-line-of-sight surface- to-air and ATGMs directed against aviation.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603270A Electronic Warfare (EW) Technology
	PROJECT DK16

Total 9276

FY 2001 Planned Program:

- 8375 – Conduct distributed interactive simulations with aviation and ground users to evaluate integrated sensors and targeting functions; define demonstration scenarios and performance measures.
  – Complete development of compact, multi-wavelength missile warning sensor modules.
  – Complete development of data fusion software/circuit card modules that provide geolocation of missile launches, radars, laser designators/beam directors, and identify emitters.
  – Complete development of data fusion software modules to generate situation awareness displays and messages, and select and manage countermeasure responses based on the specific threat.
  – Integrate integrated situation awareness and targeting hardware/software modules with suite of RF countermeasures testbed and conduct hardware-in-the-loop simulation and testing to verify end-to-end functionality.
- 1716 – Develop, integrate and test component technologies for an integrated countermeasures capability.
  – Integrate and test direct emitting diode (semiconductor) laser jamming source to reduce weight, cost, and prime power while increasing reliability.
  – Integrate and test DARPA and Army Research Laboratory microwave and millimeter wave power modules to replace traditional traveling wave tube assemblies to reduce transmitter weight and increase reliability and jamming power output.
  – Integrate and test Air Force-developed closed loop countermeasure techniques that allow the jamming waveform and power to be adapted or modulated based on missile type and range.

Total 10091

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

	COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	91280	71394	43639	24011	28840	40608	62469	59994	Continuing	Continuing
D206	Missile Simulation	2847	2435	2775	2853	3067	3846	3656	3370	Continuing	Continuing
D263	Future Missile Technology Integration (FMTI)	3834	5470	12056	6405	9439	2474	18302	16923	0	128192
D380	Multi-Platform Launcher	11685	5879	4394	6532	7192	6709	0	0	0	63210
D486	Rapid Force Projection Simulation	7806	5101	0	0	0	0	0	0	0	26291
D493	Rapid Force Projection Demonstration	34061	27712	17065	2604	0	0	0	0	0	111993
D496	Enhanced Fiber Optic Guided Missile (EFOG-M)	26568	19943	0	0	0	0	0	0	0	175488
D549	2.75 Inch Anti-Air Technology Demonstration (TD)	2661	2664	0	0	0	0	0	0	0	5499
D550	Counter Active Protection System	1818	2190	2005	1774	1772	2952	0	0	0	12689
D567	Low Cost Precision Kill (LCPK) for 2.75 Inch Rockets	0	0	5344	3843	0	0	0	0	0	9230
D655	Hypervelocity Technology Demonstration (TD)	0	0	0	0	7370	24627	24564	24525	0	78518
D704	Advanced Missile Demonstrations	0	0	0	0	0	0	15947	15176	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element demonstrates application of mature advanced missile technologies to enhance U. S. Army force structure capabilities and existing assets. Major objectives for investigation are system deployability, lethality, survivability, flexibility and affordability. Work in this program element addresses the full spectrum of missile tactical missile roles and missions and is focused on upgrades to current missile systems. Efforts are conducted through system simulation/virtual prototyping, system design, hardware development and test, and demonstration in laboratory and operational scenarios. This program

element provides for the demonstration of advanced tactical missile enhancements and includes real-time hardware-in-the-loop simulation technology, multi-role fire-and-forget seeker technologies capable of locating targets in clutter, lightweight launcher improvements and enhanced rocket accuracy, advanced technologies for missile guidance, missile warheads, and hypervelocity missile technologies. This program element also provides full integration of battlefield technologies including hunters (forward sensors) and killers (weapons) integrated through advanced command and control. These components demonstrate a system of systems approach under the umbrella of the Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD) which addresses enhanced survivability and lethality for light, early-entry U.S. forces in a contingency role. The RFPI ACTD is supported by the Dismounted Battlespace Battle Lab (DBBL) with participation from the XVIII Airborne Corps. This program element also includes demonstration of the Enhanced Fiber Optic Guided Missile (EFOG-M). In the RFPI ACTD, EFOG-M fire units and missiles (with a limited manrating) participate in the RFPI ACTD field experiment and extended user evaluation. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, Project Reliance, and supports multiple Defense Technology Objectives. This program element supports the U.S. Army Training and Doctrine Command (TRADOC) Battle Labs. Work in this program element is related to and fully coordinated with efforts in PE 0601104A (University and Industry Research Centers), PE 0602303A (Missile Technology), PE 0603238A (Air Defense/Precision Strike Technology), and PE 0603363F in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	90468	86096	52466	30567
Appropriated Value	93839	71896		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-3371	-502		
b. SBIR / STTR	-2192			
c. Omnibus or Other Above Threshold Reductions	-724			
d. Below Threshold Reprogramming	+3728			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-8827	-6556
Current Budget Submit (FY 2000 PB)	91280	71394	43639	24011

Change Summary Explanation: Funding - FY 1999 – Appropriated value reflects Congressional reduction for EFOG-M program.
FY 2000 - Funds realigned to higher priority programs (-8827).
FY 2001 - Funds realigned to higher priority programs (-6556).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology PROJECT D206

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D206 Missile Simulation	2847	2435	2775	2853	3067	3846	3656	3370	Continuing	Continuing

Mission Description and Justification: This project supports three separate but related tasks: (a) development, expansion, and improvement of hardware-in-the-loop (HWIL) simulation capabilities applicable to the evaluation of tactical missiles guided by signals in radio frequency (RF), millimeter wave (MMW), electro-optical (EO), and IR (IR) electromagnetic spectral regions. Evaluation by means of HWIL provides cost effective support to missile development throughout weapon system life cycles and permits a reduction in the number of flight tests actually performed. HWIL simulation employs actual missile guidance and control hardware operating in real-time in a non-destructive laboratory environment; (b) Distributed Interactive Simulation (DIS) via a node to the Defense Advanced Research Projects Agency (DARPA) Defense Simulation Internet; and (c) battlefield distributed simulation, which provides an all-analytical simulation of a weapon system engaging multiple targets in a simulated battlefield environment, including the effects of natural and battle-caused obscurants and disturbances. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL. Major contractors are Boeing Defense and Space Group, Seattle, WA; and Nichols Research Corporation, Huntsville, AL.

FY 1998 Accomplishments:

- 1794 - Completed development of the first stage of a computer-controlled precision signal measurement instrument (target verification monitor) for microwave and MMW radar HWIL simulation capabilities (currently supporting LONGBOW and PAC-3).
  - Integrated dichroic beam combiner, IR scene projection, and MMW signal generation technology for support of dual-spectrum (MMW/IR) HWIL simulation into a dual-spectrum HWIL simulation capability (applicable to BAT Preplanned Product Improvement (P3I) , Sense and Destroy Armor (SADARM), and Medium Extended Air Defense System (MEADS).
  - Implemented improvements to the temporal and spatial non-uniformity correction scheme for the IR laser diode array projector (LDAP) with a consequent improvement in overall projector performance (supporting Theater High Altitude Air Defense (THAAD), Enhanced Fiber Optic Guided Missile (EFOG-M), BAT P3I, Future Missile Technology Integration (FMTI).
  - Investigated application of spatial light modulators to IR scene projector technology as an alternative to LDAP and resistive element integrated circuit arrays with the objective of devising "leap ahead" IR scene projector technology.
  - Completed improvements to real-time dynamic IR scene generator software (benefits THAAD, BAT P3I, EFOG-M, FMTI).
- 1053 - Modernized the Electro-Optical Simulation System for support of EFOG-M and FMTI.
  - Implemented upgrades to the AMCOM Distributed Simulation Center (DSC) real-time processing, data display and virtual prototype simulator.
  - Upgraded battlefield test bed capabilities to support DSC exercises with integrated live, virtual and constructive forces and commenced conversion to high level architecture (HLA) compliance.

Total 2847

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology PROJECT D206

FY 1999 Planned Program:

•	1551	- Continue the development of a HWIL simulation capability for dual-spectrum (passive IR and MMW radar) guided and sensor-fuzed tactical missiles and sub-munitions to support development of BAT P3I, SADARM PI, their successors, and other dual mode guided weapons. - Upgrade IR scene projection capability by improving the laser diode projector performance and fabricating electronics for a resistive element chip of at least 512x512 pixel dimensions. Upgrade real-time target scene generator performance (frame rate and resolution) by adapting commercial off-the-shelf hardware and improved software to provide support to EFOG-M, THAAD, and other IR guided weapons. - Continue development of "leap ahead" IR scene projector technology to overcome disadvantages of present laser diode and resistive element projector systems. This technology will support all development and test and evaluation (T&E) for all IR guided missiles and submunitions.
•	823	- Provide upgraded virtual prototype and real-time computer generated forces capability for the DIS Center, including improved accuracy and lower cost to meet R&D needs. Support conversion to HLA compliance. - Implement upgraded battlefield distributed simulation test bed capability to provide improved control, integration, operation, data collection and analysis. - Upgrade battlefield distributed simulation environmental models to support engineering evaluation of enhanced weapon system seekers/sensors. Support conversion to HLA compliance.
•	61	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	2435	

FY 2000 Planned Program:

•	2075	- Extend technology for dual-spectrum (passive IR, active MMW) simulation capability to support HWIL simulation of air and missile defense interceptor kill vehicles (applicable to MEADS and Atmospheric Interceptor Technology (AIT). - Integrate HWIL capabilities for simulation of passive IR guided missile seekers and onboard tracking, guidance, and navigation processors with system ground equipment and test and evaluate physical environment conditioning simulators to apply and extend the principles of Simulation Based Acquisition to end-to-end missile system simulations (applicable to THAAD, National Missile Defense (NMD), AIT, and Antisatellite (ASAT). - Integrate resistive element integrated circuits for IR scene projection with drive electronics and non-uniformity correction hardware/software (applicable to all IR missile seeker simulations). Implement into HWIL simulation capabilities. - Implement improvements to MMW signal generation to support high-speed digital processing of intermediate frequency signals in the digital domain for radio frequency guided missiles and submunitions. - Investigate means of implementing a HWIL simulation capability for active IR laser radar (LADAR) guidance systems (applicable to future LADAR guided systems). - Develop a flight table-mountable LDAP IR scene projector to eliminate requirements for synthetic line-of-sight representation of missile-target relative motion in HWIL simulations (applicable to all IR guided missiles and submunitions).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology
	PROJECT D206

FY 2000 Planned Program: (continued)

•	700	- Extend battlefield test bed and Distributed Simulation Center capabilities to support Simulation Based Acquisition principles and investigate future battle-fighting techniques via live, constructive, and virtual simulations. - Upgrade software tools and virtual prototype applications to HLA compliance. Improve real-time computer-generated forces to support R&D requirements. - Implement improvements in the synthetic battlefield environmental effects capability to represent actual conditions with greater realism.
Total	2775	

FY 2001 Planned Program:

•	2132	- Complete the development of a dual-spectrum (passive IR, active MMW) simulation capability to support HWIL simulation of air and missile defense interceptor kill vehicles (applicable to MEADS and AIT). - Continue the development of HWIL capabilities for simulation of passive IR (and dual spectrum) guided missile seekers and onboard tracking, guidance, and navigation processors with system ground equipment and test and evaluation physical environment conditioning simulators for end-to-end missile system HWIL simulations (applicable to THAAD, NMD, AIT, and ASAT). - Develop technology components applicable to implementation of a HWIL simulation capability for active IR (LADAR) guidance systems (applicable to future LADAR guided systems). - Demonstrate a flight table-mountable LDAP IR scene projector to eliminate requirements for synthetic line-of-sight representation of missile-target relative motion in HWIL simulations (applicable to all IR guided missiles and submunitions). - Investigate and apply techniques for extending digital signal processing to signal generation of MMW radio frequency (RF) signals with the objective of improving HWIL simulator RF performance (bandwidth, sensitivity, low noise characteristics) to match or exceed developments in RF seeker technology.
•	721	- Further extend battlefield test bed and Distributed Simulation Center capabilities to support Simulation Based Acquisition principles and investigate future battle-fighting techniques via live, constructive, and virtual simulations. - Increase realism and fidelity of simulated dirty battlefield in virtual simulation applications to support refined weapon system design, development, and technology insertions. - Provide improved model fidelity for Army aviation and missile battlefield simulation applications to predict and evaluate weapon system performance with greater accuracy.
Total	2853	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology PROJECT D263

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D263 Future Missile Technology Integration (FMTI)	3834	5470	12056	6405	9439	2474	18302	16923	0	128192

Mission Description and Justification: This project provides for the demonstration of advanced tactical missile technologies including seekers, propulsion, airframes, and guidance and control. The project will demonstrate lightweight multi-role missile technology in support of ground-to-ground, ground-to-air, air-to-air and air-to-ground missions. Combined flexible capability allows one system or variants of one system to replace many, realizing potential extensive savings in development costs, logistics, training, etc. Particular attention will be given to the development of IR seeker technology capable of long range lock, variable thrust propulsion allowing system range extension and thus stand off and high survivability, and the innovative use of radio frequency (RF) data links for identification friend or foe, and the attack of targets masked from the launch platform. The missile system demonstration includes the integration of guidance, control, propulsion, and airframe technologies capable of performing in high clutter/obscurants, adverse weather environments and under countermeasure conditions. Missile control and guidance system technology will explore capabilities such as lock-on before/lock-on after launch, fire and forget, command guidance, imaging IR signal and image processing, and wide band secure data links. The objective of the Modernized HELLFIRE Technology Effort is the demonstration and integration of dual or multi-mode seeker concepts, controllable thrust rocket motors (gels or pintle-controlled solids), automatic target recognition (ATR), and wide-band secure datalinks. Seeker technology will address imaging infrared, millimeter wave, and laser radar (LADAR) seeker technologies combined with the existing semi-active laser, in order to provide precision strike and fire-and-forget guidance modes without major modifications to the host platform. Affordable, controllable thrust rocket motors, such as gelled bipropellants or pintle-controlled solids, will be demonstrated to provide longer ranges and shorter flight times while increasing system robustness in the Air-to-Ground (ATG) and Ground-to-Ground (GTG) roles. ATR will be demonstrated permitting true fire-and-forget at targets beyond visual range. Finally, secure wide-band datalink hardware, allowing target position updates during missile flight, will be demonstrated. These efforts are a risk mitigation effort in support of a FY03 EMD start for Modernized HELLFIRE and are supported by the AGMS PM. This program will leverage technologies developed and demonstrated under the Future Missile Technology Integration (FMTI) program as well as the ongoing DARPA Advanced Fire Support System (AFSS) program and will be executed in two phases: 1) the first phase will conduct detailed analysis of the above technologies for maturity, packaging, risk, and cost. 2) The second phase will design, fabricate, integrate and test a prototype Modernized Hellfire missile through live-fire demonstrations as part of the AFSS program. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL. Major contractors are Raytheon Company, Electronic Systems, Tewksbury, MA; TRW Space Electronics Group, Redondo Beach, CA; Loral Communications Systems, Salt Lake City, UT.

FY 1998 Accomplishments:

- 3834 - Integrated and captive flight-tested seeker/autotracker/guidance and navigation computer at Elgin, AFB.
  - Completed component testing of gel-bipropellent propulsion system.
  - Completed integration of flight weight datalinks.
  - Demonstrated target hand-over to target acquisition system.
  - Qualification missile (shop clean missile) integration completed.

Total 3834

FY 1999 Planned Program:

•	1457	- Conduct detailed seeker trade studies to assess imaging IR, millimeter wave, and laser radar (LADAR) seeker technologies combined with the existing semi-active laser into dual-mode seeker that will fulfill Modernized HELLFIRE requirements. - Develop detailed program plan. - Evaluate seeker concepts for contract award.
•	3868	- Perform flight test of FMTI program and full-up missile including gel bipropellant propulsion system.
•	145	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	5470	

FY 2000 Planned Program:

•	6306	- Downselect to best Modernized Hellfire (Mod HF)/ Advanced Fire Support System (AFSS) Air-to-Ground (ATG) and Ground-to-Ground (GTG) seeker concept(s) based on FY 99 seeker tradeoff studies. - Award contract(s) to design captive flight and missile flight seekers for integration on AFSS missiles.
•		- Identify alternative Mod HF/AFSS seeker which offers higher payoff and greater risk than selected primary seeker.
•	5750	- Downselect to best controllable thrust rocket motor from competing gel and pintle-solid designs for Mod HF/AFSS ATG and GTG missions. - Downselect to best Automatic Target Recognition (ATR) hardware and software which best meet ATG and GTG mission requirements for Mod HF/AFSS. - Downselect to best datalink hardware design for in-flight target position update information.
Total	12056	

FY 2001 Planned Program:

•	4505	- Complete hardware design and begin fabrication of seekers. - Conduct bench and tower test of prototype seekers. - Conduct hardware-in-the-loop testing. - Integrate seeker with missile airframe. - Begin preparations for seeker/missile flight test program.
	1900	- Complete controllable thrust motor development - Conduct static test firings of controllable thrust motor - Conduct captive flight test of ATR hardware/software - Conduct tower test of guidance datalink

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology PROJECT D263

Total 6405

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

PROJECT: D380

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D380 Multi-Platform Launcher	11685	5879	4394	6532	7192	6709	0	0	0	63210

Mission Description and Justification: The Multi-Platform Launcher (MPL) program explores and implements technologies to improve the deployability and lethality of the Multiple Launch Rocket System (MLRS) for counter battery, counter armor, and critical target missions. The first phase of the MPL program (Guided MLRS) designs, develops, and flight tests a low cost guidance and control system for the MLRS free-flight rocket, thereby substantially improving its delivery accuracy, reducing the number of rockets required to defeat the target, and expanding the set of MLRS targets to include precision targets. The guidance system will make use of inertial and Global Positioning System (GPS) low cost component technologies. A more accurate rocket results in both a more lethal force and a reduced logistics burden, which is especially important for early entry. This phase completes in FY 98 and transitions to EMD. The second phase of the program supports the design and testing of the High Mobility Artillery Rocket System (HIMARS), a C-130 transportable MLRS launcher, in the RFPI ACTD. The third phase of this program will demonstrate the technical feasibility of the MLRS Smart Tactical Rocket (MSTAR). This program will include provisions for dispensing multiple rounds of two submunition candidates from the MLRS Guided Rocket to achieve a precision strike capability for artillery rockets. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL. The major contractor is Lockheed Martin Vought Systems, Dallas, TX.

FY 1998 Accomplishments:

- 4532 - Built one prototype and five flight missiles.
  - Conducted qualification test and flight acceptance test on 6 missiles.
  - Performed three Guided MLRS flight tests with inertial measurement unit (IMU) guidance at White Sands Missile Range (WSMR), NM.
  - Performed two Guided MLRS flight tests with GPS aided IMU guidance at WSMR, NM.
  - Transferred Guided MLRS technology to EMD.
- 6851 - Completed HIMARS design.
  - Fabricated HIMARS residual hardware.
  - Tested HIMARS hardware prior to firings, including electromagnetic testing, road tests, and man rating.
  - Tested firings of HIMARS at WSMR, including range costs.
- 302 - Small Business Innovation Research/Small Business Technology Transfer Programs.

Total 11685

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology
	PROJECT D380

FY 1999 Planned Program:

•	5755	- Provide maintenance, spares, replacements, and repairs for HIMARS residuals, to be evaluated by the user as a part of the Rapid Force Projection Initiative Advanced Concept Technology Demonstration (ACTD) extended user evaluation. - Provide Improved Position Determining System (IPDS) retrofit kits for residual hardware. - Provide government furnished equipment to contractor. - Provide support for interim HIMARS maintenance facility.
•	124	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	5879	

FY 2000 Planned Program:

•	2500	- Conduct MSTAR Requirements Analysis. - Complete preliminary dispenser design. - Coordinate comparability of ongoing submunition captive flight tests.
•	1894	- Provide support for residual HIMARS launchers.
Total	4394	

FY 2001 Planned Program:

•	5727	- Complete detail design and engineering prototype MSTAR configurations. - Conduct submunition dispenser design validation tests. - Conduct air drop tests.
•	805	- Complete initial MSTAR system performance assessment.
Total	6532	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

PROJECT: D486

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D486 Rapid Force Projection Simulation	7806	5101	0	0	0	0	0	0	0	26291

Mission Description and Justification: The Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD) Simulation Support Plan and the RFPI Study Plan provide a detailed description of the simulation and analysis efforts underway to support the RFPI program. Scenario development, force-on-force modeling, and simulation are currently supported by detailed engineering models, preliminary system performance estimates/data, and other system models and simulations provided by the RFPI program and the individual Advanced Technology Demonstrations/ Technology Demonstrations (ATDs/TDs). All simulations and analyses will be performed under the guidance and supervision of the Integrated Battlefield Simulation and Analysis Team (IBSAT). Simulations and analyses will support the determination of value-added proposed technologies for the RFPI ACTD and will be utilized to determine the mix and number of developmental sensors to be used in the Advanced Warfighting Experiment (AWE) and subsequently to determine residual quantities and support requirements. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL. Major contractors are Computer Science Corporation, Huntsville, AL, and Nichols Research Corporation, Huntsville, AL.

FY 1998 Accomplishments:

- 1171 - Modified draft Ft. Benning scenarios for virtual rehearsal experiment to accommodate field elements.
  - Refined Ft. Benning terrain database.
  - Performed post-rehearsal model-experiment-model runs and analysis.
- 1752 - Performed final modifications to manned simulations.
  - Used manned simulators and semi-automated forces to provide rehearsal of ACTD experiment.
- 1739 - Performed final real/virtual hardware integration.
- 2732 - Integrated, prepared and executed ACTD experiment.
- 412 - Performed CASTFOREM tradeoff runs.

Total 7806

FY 1999 Planned Program:

- 969 - Provide virtual simulation resources to support real/virtual experiments during the residual period.
- 1551 - Apply RFPI technologies to excursion scenarios to include urban, varying terrain, weather, and countermeasures.
  - Perform post ACTD model-experiment-model runs and analysis.
  - Perform excursion runs and analysis.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology PROJECT D486

- 1745 - Provide support for manned simulator residual.

FY 1999 Planned Program: (continued)

- 713 - Perform final operational effectiveness analysis.
- 123 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5101

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

PROJECT: D493

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D493 Rapid Force Projection Demonstration	34061	27712	17065	2604	0	0	0	0	0	111993

Mission Description and Justification: The integrated system of systems concept of this Advanced Concept Technology Demonstration (ACTD) provides lightweight, responsive precision fires to destroy threat armor forces during day, night, and adverse weather. The ACTD evaluates the value added by the insertion of these new technologies into the force structure of an existing light unit in a lift constrained environment. The inserted systems consist of forward sensors (hunters), advanced C2, and a suite of standoff killers. The mix of forward sensors used to complement and enhance existing unit assets includes both manned and unmanned air and ground systems. The sensor architecture is based on the unit equipment, as documented in the U.S. Army Intelligence Master Plan and the U.S. Army Modernization Plan, and is augmented with other sensors and processors, as required, to ensure forward sensors are properly cued. Tactical sensors (organic and advanced) receive cueing information from these sensors to rapidly focus them on targets. The mix of standoff killers complements and extends the capabilities of current systems. Howitzers are organic to the Division and Corps artillery and operate in direct and general support of the Maneuver Brigade. The lightweight and Highly Mobile Artillery Rocket and Missile System (HIMARS) rocket firing platform, which uses a wheeled chassis, will be a Corps asset which is attached to the Maneuver Brigade. The deployability of the FORSCOM unit will not be affected throughout the evaluation of the systems. The ACTD includes both simulation and field demonstration phases, and encourages user exploration of excursions from the baseline Tactics, Techniques, and Procedures (TTPs) to optimize utility of the standoff killers, forward sensors, and advanced C2 for the light forces. The RFPI ACTD field experiment was completed in 4QFY98, followed by an extended user evaluation of residual quantities. Integrated demonstration work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL. Major contractors are Nichols Research Corporation, Huntsville, AL; and Computer Sciences Corporation, Huntsville, AL.

FY 1998 Accomplishments:

- 9529 - Provided RFPI and Opposition Forces (OPFOR) instrumentation and support, including targets.
  - Provided communications support for experiment, including equipment spares/TAC radios.
  - Provided additional sensors and sensor support equipment.
- 12470 - Developed hardware and software for special test instrumentation.
  - Conducted user training and perform installation and checkout of System-of-Systems experiment instrumentation.
  - Conducted large scale field experiment.
  - Prepared for residual support.
- 8951 - Provided logistics support for ACTD.
  - Provided support for training and troops.
  - Provided support for residual hardware.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology
	PROJECT D493

FY 1998 Accomplishments: (continued)

		- Provided support for program evaluation and integration.
	3111	- Command and control technical demonstration for RFPI.
Total	34061	

FY 1999 Planned Program:

•	7085	- Provide maintenance, replacement parts, and spares in direct support of user units.
		- Provide spare batteries, cables, and other replacement parts for communications equipment.
		- Provide RFPI integrated logistics support, personnel, analysis, and training.
•	13920	- Provide training on residual equipment for experiment units.
		- Provide residual support for hunter/killer systems.
•	6056	- Provide analysis and red team support including countermeasure/counter-countermeasure analysis and preparation for possible milestone review.
•	651	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	27712	

FY 2000 Planned Program:

•	11244	- Provide support for residual RFPI elements.
		- Provide training on residual elements to user units.
		- Provide spares/replacement parts for residual elements.
•	1921	- Provide analysis and red team support, including support for possible milestone reviews.
•	3900	- Evaluation of select RFPI residuals in Joint Contingency Force (JCF) Advanced Warfighting Experiment (AWE).
Total	17065	

FY 2001 Planned Program:

•	1448	- Provide support for residual RFPI elements including disposition.
•	1156	- Provide support to PEOs/PMs for RFPI element analysis/transition.
Total	2604	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

PROJECT: D496

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D496 Enhanced Fiber Optic Guided Missile (EFOG-M)	26568	19943	0	0	0	0	0	0	0	175488

Mission Description and Justification: EFOGM is the primary "killer" within the Office of the Secretary Defense (OSD) approved Rapid Force Projection Initiative (RFPI) ACTD. The EFOGM system is a multi-purpose, precision kill weapon system. The primary mission of the EFOGM is to engage and defeat threat armored combat vehicles, other high value ground targets, and hovering or moving rotary wing aircraft that may be masked from line of sight direct fire weapon systems. EFOGM is a day/night, adverse weather capable system that allows the maneuver commander to extend the battle space beyond line of sight to ranges up to 15 kilometers, thus reducing the exposure of the gunner and allowing targets to be taken out of the battle early. The system consists of a gunner's station, a tactical missile, and a fiber optic data link plus command vehicles. The missile can navigate to the target area automatically, and the gunner can intervene at any time to lock on and engage any detected targets. This gunner in the loop capability enhances the target acquisition process and minimizes fratricide and collateral damage. The gunner views the flight path and target via a seeker on the missile linked to the gunner's video console. The missile incorporates an IR imaging seeker and a variety of advanced targeting functionalities. The RFPI ACTD field exercise demonstrated airlift constrained, enhanced power projection capabilities through the development and evaluation of new technologies and tactics for early entry forces. This ACTD field exercise demonstrated a semi-automated target transfer from forward sensors (hunters) to an EFOGM weapon system (killer) using C3 integration and provide gunners and platoon leaders situational awareness not previously available. It explored the capability to expand the brigade level battlespace through the use of simulation, TRADOC Battle Lab warfighting experiments and demonstrations. The ACTD demonstrated the ability to conduct essential targeting and intelligence collection using forward sensors and real-time communications to provide for precision engagements against a variety of high priority targets, including armored vehicles. The EFOGM weapon system has been tested and qualified for sling load (UH-60L and CH-47D) to support all XVIII Airborne Corps light forces and will be qualified for low velocity airdrop qualified to support the 82nd Airborne Division.

FY 1998 Accomplishments:

- 11841 - Delivered 8 fire units, 2 platoon leader vehicles, 2 upgraded stationary simulators, and 3 developmental missiles (2 controlled test vehicle flight missiles and 1 guided test vehicle flight missile) for developmental testing and ACTD demonstration.
  - Conducted simulated missile flight operations, and live developmental missile flight test.
  - Participated in the RFPI ACTD field exercise.
- 3962 - Performed test planning, test facility/range operations, test data reduction, and provided targets and target support for simulated missile flights, and the developmental missile flight test.
  - Developed and conducted soldier training courses using tactical fire units, stationary simulators, and missile mass simulators, delivered operator equipment manuals, and conducted planning for hardware delivery and deployment.
  - Provided spares and repair parts and maintained hardware and software during testing, soldier training, and the RFPI ACTD field exercise.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology
	PROJECT D496

FY 1998 Accomplishments: (continued)

•	5068	- Supported RFPI deployment testing and early entry lethality analyses. - Provided engineering analyses support of hardware manufacturing and acceptance test. Supported hardware upgrade engineering analyses and design.
•	5697	- Programmatic and technical integrated product team support for engineering design, developmental test planning and conduct, cost and schedule control, affordability and producibility analyses, and risk management and mitigation efforts.
Total	26568	

FY 1999 Planned Program:

•	11037	- Conduct 4 guided test vehicle developmental missile flight tests. - Conduct warhead test, impact fuze sensor/propulsion evaluation, production flight readiness test, Lucent fiber qualification tests, engineering road test of fire unit/missile, and live developmental missile flight tests. - Complete upgrade of the residual ACTD assets (8 fire units and 2 platoon leader vehicles) after completion of the ACTD field exercise. - Continue systems support for ACTD hardware for the XVIII Airborne Corps. - Evaluate tactics, techniques, and procedures and validate war fighting operations and firing doctrine.
•	2185	- Perform test planning, test facility/range operations, test data reduction, and provide targets and target support for simulated missile flights, developmental missile flight tests, and environmental, safety, transportability, and lethality testing.
•	2542	- Provide integrated product team support from a wide variety of functional areas. - Provide facilities and support to development process, including hardware-in-the-loop, hardware/software integration and verification of system capabilities.
•	3678	- Programmatic and technical integrated product team support for engineering design, developmental test planning and conduct, cost and schedule control, affordability and producibility analyses, and risk management and mitigation efforts.
•	501	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	19943	

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

PROJECT: D549

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D549 2.75 Inch Anti-Air Technology Demonstration (TD)	2661	2664	0	0	0	0	0	0	0	5499

Mission Description and Justification: The objective of this project is to demonstrate the technology for a comprehensive upgrade to the STINGER missile system through the incorporation of an advanced imaging IR (IR) seeker to enable the engagement of hostile helicopters in clutter at extended ranges (2-3x). This project will demonstrate the ability to package the previously developed commercial breadboard signal processing electronics in a 2.75 inch diameter seeker. In addition, signal processing algorithms for target detection, tracking, and IR counter-countermeasures (IRCCM) will be developed and demonstrated via hardware in the loop simulations, ground tests, and captive carry tests. This seeker will maintain compatibility with existing STINGER launchers and retain STINGER's excellent capability against fixed wing aircraft. This program completes in FY 99. Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL.

FY 1998 Accomplishments:

- 1570 - Completed form-factored seeker electronics.
  - Developed endgame and IRCCM signal processing algorithms.
- 1091 - Developed Hardware-In-the-Loop (HWIL) simulation.
  - Performed acquisition and tracking tests.
  - Performed IRCCM tracking tests.

Total 2661

FY 1999 Planned Program:

- 1500 - Complete endgame and IRCCM signal processing algorithms.
  - Complete HWIL simulation.
  - Perform HWIL missile flight simulations.
- 1102 - Develop platform/launcher interfaces.
  - Perform captive carry air-to-air tests.
  - Perform environmental tests.
- 62 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2664

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology
	PROJECT D549

FY 2000 Planned Program: Project not funded in FY 2000.

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

PROJECT: D550

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D550 Counter Active Protection System	1818	2190	2005	1774	1772	2952	0	0	0	12689

Mission Description and Justification: This project will develop and demonstrate technologies which can be applied to Anti Tank Guided Weapons (ATGW) for improving their effectiveness against threat armor equipped with active protection systems (APS). Current technology development is concentrated in the following areas: radio frequency (RF) countermeasure (RFCM) technology for jamming or deceiving APS sensors used for detection, acquisition, and tracking; warhead integration and ballistic hardening of ATGW to reduce vulnerability to fragment impact. Develop and demonstrate sensors (salvage fuzing sensors) for detecting attack of anti-tank missiles by active protection munitions and firing the missile warhead before it can be destroyed. . Work is performed by the Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL.

FY 1998 Accomplishments:

- 1818 - Completed CAPS dynamic field test apparatus.
  - Fabricated and test 2nd generation prototype jammer.
  - Designed 2nd generation testbed APS and buy long lead items for fabrication of test bed radar.
  - Completed integration of Soft Kill into midterm APS models.

Total 1818

FY 1999 Planned Program:

- 2142 - Complete 2nd generation test bed APS radar.
  - Fabricate, integrate, and test 2nd generation RFCM flight prototypes.
- 48 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2190

FY 2000 Planned Program:

- 2005 - Fabricate APS munition test bed phase 1.
  - Conduct dynamic tests of salvage sensor breadboard.
  - Mature RF components for 3rd generation RFCM breadboard.
  -

Total 2005

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology
	PROJECT D550

FY 2001 Planned Program:

•	1774	- Fabricate selected salvage sensor prototype and dynamic sled tests against APS munition test bed. - Complete APS munition test bed.
Total	1774	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603313A Missile and Rocket Advanced Technology

PROJECT: D567

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
D567 Low Cost Precision Kill (LCPK) for 2.75 Inch Rockets	0	0	5344	3843	0	0	0	0	0	9230

Mission Description and Justification: This project provides for demonstration of a low cost, accurate (1-m CEP) guidance and control package for the 2.75-inch Hydra-70 rocket that provides a stand-off range ($\geq$ 6 km) capability against specified non-tank point targets. The retrofit guidance package will allow utilization of large existing Hydra 70 rocket motor, warhead, and fuze inventories. This capability will provide for a high single shot probability of hit (Ph$\geq$ 0.7) against the long range target, exceeding the current unguided 2.75-inch rocket baseline by 1 or 2 orders of magnitude and thereby providing a 4 to 1 increase in stowed kills at one third the cost per kill compared to current guided missiles. The resulting decrease in logistics burden is of significant benefit to a CONUS-based force projection Army and of particular importance in a rapid force projection scenario. In addition, the increased accuracy will minimize collateral damage, reduce risk of fratricide, and will reduce mission times and sorties resulting in increased system survivability. The program will demonstrate technologies and techniques to overcome barriers such as providing a low cost, producible strapdown mechanism for precision guidance; robust design for rolling airframe applications; component packaging in 2.75 - inch airframe; structural, vibration and shock considerations for guidance package retro-fit to current 2.75 - inch Hydra-70 rockets; and stand-off range target acquisition and engagement techniques to address current free-rocket launch and flight dispersions. Work will be performed by the Research, Development, and Engineering Center, U. S. Army Aviation and Missile Command, Redstone Arsenal, Al.

FY 1998 Accomplishments: Project not funded in FY 1998

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program:

•	4000	- Award contract(s) for design and fabrication of laser guidance package(s) and associated flight test support.
•	1344	- Perform ground launched control test vehicle flight tests, demonstrate stable airframe control.
		- Upgrade and validate 6 degrees of freedom (DOF) simulation(s).
Total	5344	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603313A Missile and Rocket Advanced Technology
	PROJECT D567

FY 2001 Planned Program:

•	3500	- Perform HWIL evaluations of contractor guidance section.
		- Perform ground launched guided test vehicle flights of contractor guidance sections.
•	343	- Upgrade and validate 6-DOF simulation(s).
•		- Support pre/post flight predictions/analysis.
Total	3843	

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare and Barrier Advanced Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	30529	23777	47456	44935	49684	50305	71316	101799	Continuing	Continuing
D608 Countermine & Barrier Development	20317	21790	27726	18327	20151	20785	22189	23318	Continuing	Continuing
D624 Ground Penetrating Radar Technology	3654	1987	0	0	0	0	0	0	0	8531
D674 Airborne Standoff Minefield Detection System	6558	0	0	0	0	0	0	0	0	6558
D683 Anti-Personnel Landmine (APL) Alternatives	0	0	19730	26608	29533	29520	49127	78481	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element provides for the development and demonstration of countermine technologies. Advanced Technology Demonstrations (ATDs), advanced warfighting experiments, and modeling and simulation will be conducted to verify the system of systems approach, providing support for the shallow water/beach/land assault phase (Demo II) of the Navy, Army, and USMC joint countermine advanced concept technology demonstration (ACTD). The specific efforts include remote detection of minefields and detection of individual mines from moving vehicles and aerial platforms, all of which must work against both traditional (metallic) mines and mines made from advanced materials. Breaching techniques will be developed for both conventional and electronically activated mines that can act at a distance. Operation Desert Storm and the humanitarian operations in Somalia have highlighted the need for new equipment to detect and neutralize land mines. The Army's highest priority requirements are in-stride detection and breaching, and close-in detection and neutralization of landmines. Multi-sensor fusion will be used in vehicle-mounted mine detectors and airborne multispectral/hyperspectral minefield detectors to sense surface-laid and buried mines. Alternative systems for anti-personnel landmines will also be explored. The Army has focused its resources and is expediting these programs in coordination with the US Marine Corps. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on conventional air/surface weapons and ground vehicles. Work in this program element is related to and fully coordinated with PE 0603691A (Landmine Warfare and Barrier Advanced Development), PE 0602784A (Military Engineering Technology), PE 0602712A (Countermine Technology), and PE 0602709A (Night Vision and Electro-Optics Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare and Barrier Advanced Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	31581	21944	36044	19559
Appropriated Value	32932	23944		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1351	-167		
b. SBIR / STTR	-791			
c. Omnibus or Other Above Threshold Reductions	-261			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+11412	+25376
Current Budget Submit (FY 2000 / 2001 PB)	30529	23777	47456	44935

Change Summary Explanation: Funding - FY 1999 – Congressional add for Ground Penetrating Radar (+2000).
FY 2000/2001 – Funding increased to develop anti-personnel landmine alternatives (APLA).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare and Barrier Advanced Technology

PROJECT: D608

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D608 Countermine & Barrier Development	20317	21790	27726	18327	20151	20785	22189	23318	Continuing	Continuing

Mission Description and Justification: This project provides advanced technology demonstrations of countermine capabilities. The specific efforts include remote detection of minefields, detection of individual mines from moving vehicles and aerial platforms, all of which must work against both traditional (metallic) mines and mines made from advanced materials. Multi-sensor fusion will be used in the vehicle-mounted mine detector ATD and airborne multispectral/hyperspectral minefield detector to sense surface-laid and buried mines. A new generation of standoff sensors and explosive/directed energy mine neutralization technologies will be integrated in a Mine Hunter/Killer ATD. The Mine Hunter/Killer will be capable of detecting and destroying mines at maneuver speeds. This project supports advanced warfighting experiments and modeling and simulation that are key elements of the shallow water/beach/land assault phase of the Navy, Army, and USMC joint countermine Advanced Concept Technology Demonstration (ACTD).

FY 1998 Accomplishments:

- 7293 – Analyzed data from joint countermine ACTD demo I, applied lessons learned to demo II planning, and executed demo II.
  – Assessed contribution of new countermine technology to survivability of convoy/rear area assets, in battle lab experiment.
  – Added fidelity to joint countermine ACTD novel system models and conducted sensitivity studies; completed modeling of false targets for detection systems and transitioned to joint countermine operational simulation. Continued validation and verification activities.
- 3000 – Completed development of three vehicular mounted mine detector prototypes with alternative multisensor fusion design approaches, conducted comparative performance testing, and selected system(s) for final Vehicular Mounted Mine Detector (VMMD) ATD.
  – Completed vehicular mounted mine detector ATD and transitioned program design and test documentation to ground standoff mine detection system engineering and manufacturing development program.
- 7496 – Studied neutralization technologies for the mine hunter/killer and completed restructured plans for mine hunter/killer ATD execution.
  – Performed development of advanced standoff ground penetrating radar (GPR) sensor to allow greater standoff mine detection distances and faster forward speeds.
- 2528 – Standardized three vehicular mounted mine detector prototypes by incorporating electronic marking capability, common platforms, and GPS capabilities.
  – Completed demonstration and performance characterizations of alternative vehicular mounted mine detectors.

Total 20317

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology PROJECT D608

FY 1999 Planned Program:

- 2689 – Develop models and simulations for joint countermine ACTD technologies and integrate into service models with new architecture, continue verification and validation. Receive final user report on novel system military suitability.
  – Conduct assault-on-objective battle lab experiment and assess contribution of new countermine technology to survivability and mobility of assault forces.
- 8885 – Fabricate prototype "stand-off" GPR for integration with mine hunter/killer demonstrator.
  – Integrate prototype detection and neutralization technologies into mine hunter/killer ATD.
  – Complete contractor testing on mine hunter/killer platform.
  – Complete site preparation for the mine hunter/killer ATD.
- 9697 – Complete requirements analysis, definition of aircraft constraints and interfaces, and technology trade-offs for lightweight imaging multispectral airborne minefield detection technology.
  – Collect mine signature data to support finalization of phenomenology studies and mine detection algorithm development.
  – Develop critical components for multispectral minefield detection sensor.
- 519 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 21790

FY 2000 Planned Program:

- 9510 – Evaluate mine hunter/killer integration of close-in detection and neutralization capability with a goal of dramatically improving the rate at which maneuver/transport lanes are cleared versus current capabilities.
  – Demonstrate and evaluate tele-operation capability of mine hunter/killer for an off-route mission scenario.
  – Develop and evaluate precision neutralization technologies against surface and buried AT mines in various soils, overburden and environmental conditions with goal of demonstrating greater than a 90% probability of kill for a neutralization capability.
  – Conduct constructive and virtual modeling and simulation to evaluate and refine future mine hunter/killer capabilities for on and off-route scenarios.
- 14408 – Develop minefield detection aided target recognition (AiTR) algorithms to improve airborne minefield detection performance (increase probabilities of detection and reduce false detection rates).
  – Perform ground and airborne data collections using multiple sensors that will provide data to support phenomenology investigations, multi/hyperspectral AiTR algorithm development and algorithm performance evaluations for ground and airborne mine/minefield detection sensors.
  – Develop system and component requirements/specifications and preliminary design of lightweight multi/hyperspectral minefield detection sensor that will be compatible with future tactical or short range UAVs (weight goal less than 65 lbs.) and capable of performing in a broad range of environments.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology PROJECT D608

FY 2000 Planned Program: (continued)

– Perform benchmark demonstration of the multi/hyperspectral minefield detection capability to establish multi/hyperspectral minefield detection performance baseline.

3808 – Analyze data from joint countermine ACTD demo II, apply lessons learned to technology programs and provide support for residual hardware.

– Leverage lessons learned in humanitarian demining program through DOD assessment of utility in military area clearance operations.

Total 27726

FY 2001 Planned Program:

- 3490 – Develop data collection and analysis plans. Obtain HSTAMIDS and GSTAMIDS sensor suites and other candidate sensor technologies for data collections for investigations in background analyses and false alarm reductions for mine detection technologies.

– Refurbish data collection sites; collect data and review for applicability and exploitation

- 14837 – Fabricate, build, and integrate lightweight multi/hyperspectral sensor that will be TUAV compatible (weight goal less than 65 lbs.) and capable of performing in a broad range of environments.

– Develop advanced minefield detection AiTR algorithms and enhance fusion approaches to improve airborne minefield detection (increase probabilities of detection and reduce false detection rates).

– Integrate TUAV system with lightweight sensor and real-time minefield detection AiTR algorithms to demonstrate the ability to achieve the Army's airborne minefield detection requirements.

– Develop and design a test and evaluation strategy that will fully test the lightweight multi/hyperspectral technology's ability to achieve the Army's airborne minefield detection requirements.

Total 18327

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare and Barrier Advanced Technology

PROJECT: D624

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D624 Ground Penetrating Radar Technology	3654	1987	0	0	0	0	0	0	0	8531

Mission Description and Justification: This Congressional special interest program provided for the development and evaluation of stand-off ground penetrating radar (GPR) technologies for mine detection. Continued development of standoff mine detection capabilities will be funded in this PE in project D608 in FY00 and beyond.

FY 1998 Accomplishments:

- 3654 – Completed efforts to enhance GPR detection algorithm performance, using detection algorithm test results.
  – Completed additional testing and evaluation of standoff GPR detector performance in vehicular mounted mine detector test scenarios.

Total 3654

FY 1999 Planned Program:

- 1934 – Upgrade Phase I system for Phase II forward looking system.
  – Enhance power amplifiers for better antenna gain and improve digitizers for increased processing capability.
  – Enhance and integrate GPS system for inertial navigation and mine identification processing capability.
  – Upgrade software to improve performance of both GPR and FLIR sensors.
- 53 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1987

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare and Barrier Advanced Technology

PROJECT: D674

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D674 Airborne Standoff Minefield Detection System	6558	0	0	0	0	0	0	0	0	6558

Mission Description and Justification: This Congressional special interest program provided for the development and evaluation of airborne minefield detection capabilities. Continued development of a multispectral / hyperspectral mine detection capability will be funded in this PE in project D608 in FY99 and beyond.

FY 1998 Accomplishments:

- 6558 – Collected airborne mine and minefield data using infrared and multispectral/hyperspectral sensors to support development and refinement of robust mine detection algorithms.
  – Developed, integrated, and evaluated enhanced airborne mine detection algorithms. These enhanced algorithms will be capable of exploiting data from single color infrared sensors, as well as multispectral/hyperspectral imaging sensors.
  – Enhanced sensor imaging resolution and sensitivity, and assessed performance of the airborne mine detection sensor as a testbed.
  – Transitioned algorithm data and sensor characterizations to lightweight airborne multispectral minefield detection development program.

Total 6558

FY 1999 Planned Program: Program not funded in FY 1999

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare and Barrier Advanced Technology

PROJECT: D683

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D683 Anti-Personnel Landmine (APL) Alternatives	0	0	19730	26608	29533	29520	49127	78481	Continuing	Continuing

Mission Description and Justification : This project provides advanced technology demonstrations of alternative systems for anti-personnel landmines (APLs). This includes alternatives to anti-personnel submunitions used in mixed anti-tank (AT) landmine systems and possibly the entire mixed landmine system themselves. The alternatives systems will include surveillance systems, command and control systems, and overwatch fires which will be evaluated and developed in parallel to provide similar capabilities that are now provided by APLs and APL submunitions in mixed AT systems. Distributed simulation will be used to evaluate new concepts and modify tactics and procedures. Prototype components and system architectures will be constructed and evaluated in system field tests. This effort continues the work started in PE 603121D8Z and concept exploration study congressional plus up in 604808A.

FY 1998 Accomplishments: Project not funded in FY 1998.

FY 1999 Planned Program: Project not funded in FY 1999.

FY 2000 Planned Program:

- 2000 - Complete concept exploration studies.
- 11730 - Evaluate the use of low cost sensors for remote detection, assessment and early warning of incoming targets. Leverage commercial and current military sensors and build prototypes for field test.
  - Evaluate current command, control, communications, and computer (C4) components and optimize implementation for use in landmine alternative system architecture. Include assessment of communications vulnerability, investigate novel low cost, short range communications devices for minefield components and sensor networking, and digitize minefield operations to provide situational awareness. Build prototypes for field test.
  - Evaluate the use of advance deterrent and fuzing systems including wide area munitions and nonlethal technology for insertion to landmines for anti-handling capability and/or to provide man-in-the-loop overwatch fire capability. Build prototypes for field tests.
- 3000 - Evaluate modifying current mixed system delivery systems for use with landmine alternative system concepts.

3000 - Use distributed modeling to modify tactics and procedures for landmine alternative system architectures.

Total 19730

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603606A Landmine Warfare and Barrier Advanced Technology PROJECT D683

FY 2001 Planned Program:

•	5000	- Complete component field test and develop near term system architecture for landmine alternatives system.
•	5000	- Modify and leverage on going development in advanced sensors, C4 components and advanced deterrent and nonlethal mechanisms to improve performance and operational utility of landmine alternative system concepts. -Utilize distributed simulations to modify systems concepts and model advance technology prototypes to refine landmine alternatives system.
•	16608	- Weaponize alternative landmine system components and demonstrate in advanced warfighter field test. - Provide field harden prototypes for user tests. - Demonstrate artillery, air drop and other scatterable delivery mechanisms of landmine alternative system prototypes. - Demonstrate landmine alternative system C4 interfaces with digital battlefield. - Modify landmine alternative system architecture based on user feedback.
Total	26608	

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603607A Joint Service Small Arms Program

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	8784	9608	4869	5468	5839	5954	6376	6700	Continuing	Continuing
D627 Joint Service Small Arms Program (JSSAP)	7284	9608	4869	5468	5839	5954	6376	6700	Continuing	Continuing
D664 Advanced Lightweight Anti-Armor Weapon Sys	1500	0	0	0	0	0	0	0	0	1500

A. Mission Description and Justification: The objective of this Program Element (PE) is to demonstrate key technologies leading to more effective small arms weapons and munitions for all Services. The Joint Services Small Arms Program (JSSAP) is designed to overcome the technological barriers associated with small arms/munitions/fire control for individual and crew-served weapons. The goal is to achieve substantial improvements in threat defeat under all environmental conditions while reducing the soldier's load. All JSSAP efforts are based upon the Joint Service Small Arms Master Plan (JSSAMP), and approved Joint Service Science and Technology Objectives (JSSTO), plus Mission Needs Statements and Operational Requirements Documents of the Services. The work in this PE is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ primarily manage these programs. Work in this PE is related to and fully coordinated with efforts in PE 0602623A (Joint Service Small Arms Program), PE 0602624A (Weapons and Munitions Technology), and transitions to JSSAP efforts conducted in PE 0604802A (Weapons and Munitions-Engineering Development) and PE 0604601A (Objective Crew Served Weapon-Engineering Development). Additional transition paths have been established in coordination with Product Manager (PM) Small Arms, USMC Program Manager (PM) Ground Weapons and US Special Operations Command (SOCOM).

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	9015	5173	5031	5691
Appropriated Value	9254	9673		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-239	-65		
b. SBIR / STTR	-174			
c. Omnibus or Other Above Threshold Reductions	-57			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			-162	-223
Current Budget Submit (FY 2000 / 2001 PB)	8784	9608	4869	5468

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603607A Joint Service Small Arms Program**

Change Summary Explanation: Funding - FY 1999 Congressional increases of $3.5M for Objective Crew Served Weapon and $1.0M for Objective Individual Combat Weapon.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603607A Joint Service Small Arms Program PROJECT D627

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D627 Joint Service Small Arms Program (JSSAP)	7284	9608	4869	5468	5839	5954	6376	6700	Continuing	Continuing

Mission Description and Justification: This project funds several efforts: (1) Objective Individual Combat Weapon (OICW) Advanced Technology Demonstration (ATD), which will provide a 300% to 500% increase in hit probability, the ability to defeat defilade or non-visible targets, and increase effective range to 1000 meters; (2) Objective Crew Served Weapon (OCSW) ATD which will demonstrate the next generation crew-served weapon to replace selected M2 machine guns and MK19 grenade machine guns (GMG), a two-soldier portable system that provides substantial improvements in system effectiveness including the ability to defeat defilade or non-visible targets while featuring a 60-75% weight reduction; (3) controlled penetration ammunition, intended to minimize collateral damage in confined operational environments; and (4) a new Joint service combat shotgun meeting the requirements of all the Services, increasing versatility, and reducing logistics burden.

FY 1998 Planned Program:

•	5913	- Completed OICW technology demonstration by two competitive contractor teams.
		- Downselected to a single OICW contractor team.
•	1171	- Conducted initial design refinement and hardware build for OICW Advanced Technology Demonstration (ATD).
•	200	- Updated joint combat shotgun requirements; released request for proposals; obtained candidate hardware.
Total	7284	

FY 1999 Planned Program:

•	4631	- Complete hardware build for OICW ATD.
•	567	- Conduct OICW live fire simulation/field test and prepare for Milestone I/II.
•	4168	- Integrate initial system design refinements into OCSW prototype weapon.
		- Conduct OCSW 2000 meter dispersion critical test demo; complete precision air burst design effort plus fragmentation study.
		- Enhance OCSW fire control application and address interface for combat identification (friend/foe), plus Land Warrior interoperability.
		- Complete joint combat shotgun testing, selection and Milestone III.
•	242	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	9608	

FY 2000 Planned Program:

•	1208	- Complete OCSW system design refinements of a lightweight (less than 50 lb.) weapon (gun, pintle, traverse and elevation, and tripod).
•	1300	- Demonstrate OCSW fuze setting in rapid-fire (3-5 round burst mode).
•	2361	- Conduct 1000-2000 meter firing tests of OCSW launched, high explosive, airburst munition.
Total	4869	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603607A Joint Service Small Arms Program
	PROJECT D627

FY 2001 Planned Program:

•	311	Demonstrate Force XX1 Land Warrior projected interoperability of OCSW.
•	1040	Demonstrate OCSW thermal module capability, leveraging OICW and other applicable technologies.
•	3157	Complete planning of OCSW safety release testing and fabricate initial testing hardware.
•	960	Demonstrate integrated OCSW system: weapon/ammunition/fuze/fire control.
Total	5468	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603607A Joint Service Small Arms Program

PROJECT: D664

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D664 Advanced Lightweight Anti-Armor Weapon Sys	1500	0	0	0	0	0	0	0	0	1500

Mission Description and Justification: Congress funded this project to further the demonstration and evaluation of advanced warhead technologies that would significantly increase the individual soldier capability to attack light armored vehicles, and noted the relevance of such technologies to the Objective Crew Served Weapon (OSCW).

FY 1998 Planned Program:

- 1500 - Completed and verified three penetrator material warhead designs capable of meeting OSCW light armor penetration objective.
  - Completed mechanical fuze initiating train for armor penetrating cartridge design applicable to the OSCW.

Total 1500

FY 1999 Planned Program: This project is not funded in FY 1999.

FY 2000 Planned Program: This project is not funded in FY 2000.

FY 2001 Planned Program: This project is not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603654A Line-of-Sight Technology Demonstration

PROJECT: D460

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D460 LOSAT Technology Demonstration	4683	11920	41619	52940	57527	26565	0	0	0	357730

A. Mission Description and Budget Item Justification: This program focuses on integration of the Line-of-Sight Anti-Tank (LOSAT) weapon system into an air mobile configuration in order to help remedy light forces lethality shortfall against heavy armor. 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 near term advanced capability for overwhelming armor destruction with a high rate of fire, increased range, and increased force survivability. LOSAT, deployed in the light forces, will provide the decisive edge to win swiftly with minimum causalities, and provides an assault support weapon capability. LOSAT is strategically and tactically deployable, giving Commanders and decision makers greater flexibility. The performance of this hypervelocity kinetic energy missile (velocity of a mile per second) is not affected by the proliferation of emerging threat active protect 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 FY1998 to position the technology for future acquisition decisions; demonstrate subsystem capabilities in flight tests and dirty battlefield environment; evaluate the utility of the LOSAT technology for light forces; demonstrate an integrated HMMWV based LOSAT system in flight test and advanced warfighting experiments; and evaluate affordability issues. The ACTD program is a cost-effective means to assess the operational value of LOSAT to light forces through deployment with the XVIII Airborne Corps while longer term Army After Next applied research efforts continue for a small Compact Kinetic Energy Missile. The work in this program element is consistent with the Army Science and Technology Master Plan, and the Army Modernization Plan. Work on this program is conducted through the CCAWS Project Office in Huntsville, AL. The prime contractor is Lockheed Martin-Vought Systems, Grand Prairie, TX. Subcontractors are Raytheon, Dallas, TX, and Honeywell, Minneapolis, MN.

FY 1998 Accomplishments:

- 1775 - Developed test missile software.
- 2610 - Designed/fabricated missile prototype electronic hardware and Inertial Measurement Unit (IMU), and conducted hardware in-the-loop (HWIL) tests.
- 298 - Initiated fire unit software development.

Total 4683

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603654A Line-of-Sight Technology Demonstration PROJECT D460

FY 1999 Planned Program:

•	4294	- Conduct design analyses of fire unit electro-optical system and carbon dioxide pulsed laser.
•	3133	- Conduct initial design and review of missile mechanical design/and initiate ACTD prototype material purchase to be used in testing.
•	2785	- Conduct initial design and review of fire unit mechanical design, and initiate ACTD prototype material purchases to be used in testing.
•	1160	- Conduct HWIL/closed loop simulation (CLS) evaluation/verification of new hardware/software designs.
•	232	- Initiate design of prototype tooling and test equipment.
•	316	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs..
Total	11920	

FY 2000 Planned Program:

•	1248	- Conduct weapon system detailed design review and assess all soldier/user issues.
•	9572	- Complete missile design, conduct component tests, and initiate fabrication of prototype tactical missile.
•	8740	- Complete fire unit design, and component tests, and initiate fabrication of prototype tactical fire unit.
•	8324	- Conduct software code and test of fire unit and missile software requirements.
•	1249	- Conduct HWIL/CLS simulation evaluation/verification of new hardware/software designs.
•	1665	- Complete design of training equipment and conduct initial user assessment.
•	8740	- Complete design/fabrication of prototype tooling and test equipment.
•	2081	- Assess alternatives to optimize LOSAT system survivability.
Total	41619	

FY 2001 Planned Program:

•	21176	- Finalize component qualification tests and begin fabrication of prototype tactical missiles.
•	17999	- Finalize component qualification tests and begin fabrication of prototype tactical fire units.
•	2118	- Perform pre-flight performance analysis/predictions in support of flight test program.
•	9529	- Finalize development and test of fire unit and missile software for use in flight tests and soldier demonstrations.
•	2118	- Fabricate and deliver training devices and prototype simulators for initial soldier training.
Total	52940	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603654A Line-of-Sight Technology Demonstration

PROJECT: D460

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	4845	20099	40435	55886
Appropriated Value	4845	12000		
Adjustments to Appropriated Value				
a. Congressional General Reductions		-80		
b. SBIR / STTR	-122			
c. Omnibus or Other Above Threshold Reduction	-40			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1184	-2946
Current Budget Submit (FY 2000/2001 PB)	4683	11920	41619	52940

Change Summary Explanation: Funding - FY 1999 – Appropriated value reflects Congressional funding reduction.

THIS PAGE INTENTIONALLY LEFT BLANK

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	17628	27273	36628	37035	41416	37726	34348	32756	Continuing	Continuing
DK70 Night Vision Advanced Technology	4584	9633	16640	17892	19419	18965	20917	20870	Continuing	Continuing
DK86 Night Vision, Airborne Systems	7846	11779	14428	10419	9913	9935	10595	9391	Continuing	Continuing
DK87 Night Vision, Combat Vehicles	4603	0	0	0	0	0	0	0	0	4603
DK89 Millimeter Wave Technology	0	3477	0	0	0	0	0	0	0	3477
DC63 DC63	595	0	0	0	0	0	0	0	0	3958
DC65 DC65	0	2384	2400	2375	2877	2893	2836	2495	Continuing	Continuing
DC67 DC67	0	0	3160	6349	9207	5933	0	0	0	25028

A. Mission Description and Budget Item Justification: This program element (PE) develops new and improved tactical night vision and electronic sensor technologies for surveillance, reconnaissance, target acquisition, air defense, pilotage, and driving technology to meet future Army requirements and applications. This technology will provide the capability to acquire and engage hostile targets at extended ranges during day/night, smoke, obscured weather and battlefield conditions, significantly enhancing the warfighting capability and survivability of US forces. Multisensor target acquisition suites will be demonstrated to provide rapid automatic acquisition of targets and battlefield intelligence data to allow US forces to operate and react well within the operational timelines of threat forces. Multispectral and hyperspectral sensors will provide the capability to detect obscured, concealed, and reduced signature threats. Improved linkages between distributed sensors and command, control, communications, computers and intelligence (C4I) systems will enable timely and seamless transmission and understanding of sensor information across multiple battlefield users. Efforts are also directed toward technology for wide field-of-view (FOV) sensors to support dismounted soldier mobility and day/night nap-of-the-earth pilotage at high speeds. Advanced tactical reconnaissance and surveillance sensor technologies will provide improved real-time capabilities for imaging intelligence (IMINT) and measurement and signature intelligence (MASINT) applications. Passive millimeter wave imaging technology will be demonstrated for all weather mission capability for air platforms. Technology advances achieved under this PE have tri-service applications.

Work in this program element is consistent with the resource-constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance agreements on sensors and electronic devices with oversight and coordination provided by the Joint Directors of Laboratories. This work is related to and fully coordinated with efforts in PE 0602709A (Night Vision and Electro-Optics Technology), PE 0602270A (Electronic Warfare Technology), PE

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology

0603774A (Night Vision Systems Advanced Development), and PE 0604710A (Night Vision Systems Engineering Development). Work in this PE is primarily managed by the US Army

Communications-Electronics Research, Development and Engineering Center (CERDEC), Ft. Monmouth, NJ. Contractors include: Raytheon., Dallas, TX; Raytheon, El Segundo, CA; Fibertek, Herndon, VA; Questech, Falls Church, VA; Northrop-Grumman, Linthicum, MD; Lockheed-Martin Corp., Orlando, FL; Lockheed-Martin, Lexington, MA; Alliant, Hopkins, MN; EOIR, Spotsylvania, VA; Booze-Allen, McLean, VA; Omar McCall, Beltsville, MD.; ThermoTrex Corporation.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	18705	23960	33487	31553
Appropriated Value	19299	27460		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-594	-187		
b. SBIR / STTR	-354			
c. Omnibus or Other Above Threshold Reductions	-123			
d. Below Threshold Reprogramming	-600			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+3141	+5482
Current Budget Submit (FY 2000/2001 PB)	17628	27273	36628	37035

Change Summary Explanation: Funding - FY 1999 – Congressional increase for new millimeter wave technology.
DC67 – FY 2000 (+2466) and FY 2001 (+4755) funds reprogrammed to this project to support development of high priority classified technologies.
DK70 – FY 2000 (+1000) and FY 2001 (+1000) reprogrammed for multisensor staring sensor suite.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

PROJECT: DK70

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DK70 Night Vision Advanced Technology	4584	9633	16640	17892	19419	18965	20917	20870	Continuing	Continuing

Mission Description and Justification: This project will develop and demonstrate affordable and high performance, sensor/multisensor technologies, increase the probability of detection, extend the range, and reduce the timelines of target acquisitions systems. The multi-function staring sensor suite (MFS3) ATD will demonstrate a modular reconfigurable sensor suite that integrates an advanced, broad-band staring infrared with multi-function laser and acoustic technology for application to future scout, fire support, and air defense missions. This technology demonstration will provide ground combat and amphibious assault vehicles with compact affordable sensor options for long range non-cooperative target recognition, air defense against low signature unmanned aerial vehicles and long range helicopters. A next generation, low power, uncooled infrared sensor will be developed to provide affordable technology upgrades to Land Warrior, Thermal Weapons Sights (TWS), Objective Crew Served Weapon (OCSW), and the Javelin anti-tank weapon system. Sensor-to-C4I interface architectures will be demonstrated to enable timely and seamless transmission, visualization and understanding of sensor information across multiple battlefield users.

FY 1998 Accomplishments:

- 4584
  - Developed performance and design requirements for the multifunction staring sensor suite ATD to provide scout and reconnaissance forces with high speed, panoramic surveillance, long range detection and identification of low signature targets.
  - Demonstrated and evaluated large format staring mid wave and long wave infrared sensors with an ultra narrow field of view to quantify long range identification performance.
  - Designed multifunction sensor suite virtual prototype to facilitate design/performance trade-offs, user evaluations of operational modes, and man-machine interfaces..

Total 4584

FY 1999 Planned Program:

- 9387
  - Complete multifunction sensor suite virtual prototype to facilitate design/performance trade-offs, user evaluations of operational modes and non-machine interfaces.
  - Developed reconfigurable, open architecture sensor back plane that fully integrates aperture, power, and signal processing requirements for infrared, laser, and acoustic sensor components.
  - Develop and implement risk reduction efforts for multifunction staring sensor suite infrared and laser sensor components.
  - Complete design trade-offs and evaluations of broad band (mid-wave and long-wave) staring infrared sensor technologies.
  - Develop broad band high-speed infrared sensor for rapid wide area search and long range target identification..
- 246 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9633

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999	
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology	PROJECT DK70

FY 2000 Planned Program:

- 13420
  - Fabricate signal processing back plane, and sensor gimbal and stabilization assembly required to implement panoramic search capability
  - Complete fabrication of the multifunction staring sensor suite staring thermal imaging sensor to satisfy the objective surveillance and target acquisition requirements of future scout, fire support, and air defense systems.
  - Conduct user demonstrations and evaluations of manually operated, 3-field of view mid wave sensor and characterize target recognition and identification performance. Specific emphasis will be placed on demonstrating the utility of the ultra narrow field of view for long-range target identification.
  - Transition performance and engineering data to support the future scout and cavalry system affordability in-process review.
  - Complete the multi-function laser simulation, trade-off, and design analyses, and transition data to support requirements definition of Army laser horizontal technology integration.
  - Conduct multifunction staring sensor suite data collections, using the broad band thermal imaging sensor, to support training of the automatic target recognition software needed for high probability of detection/recognition, wide area search modes.
- 3220
  - Complete performance and design requirements and system concept modeling and field experimentation for a modular sensor that incorporates an improved generation of uncooled infrared technology, smart power management architecture, and a next generation primary power source to provide improved performance and reduce the weight and power burden for the individual soldier .
  - Define focal plane, image processing, and image stabilization requirements to meet or exceed the Javelin command launch unit range performance for multiple sensor applications to include TWS, OCSW, and Javelin.
  - Design power management architecture and low power electronics to reduce power consumption to a level such that a 72-hour operational mission can be executed using only one primary battery.

Total 16640

FY 2001 Planned Program:

- 12545
  - Complete development of multifunction laser hardware and integration into the multifunction staring sensor suite.
  - Demonstrate rapid wide area search and aided target recognition capability.
  - Demonstrate laser rangefinding, target designating capability and target profiling that will improve ATR and target identification performance in support of future Army reconnaissance, surveillance, and target acquisition missions.
  - Complete integration of the stabilized, panoramic electro-optics sensor assembly with the ATR processing architecture and demonstrate functionality of wide area search and recognition functions.
  - Complete hardware/software integration of multifunction staring sensor suite into the demonstration platform and perform end-to-end system functional tests and checkout.
  - Conduct field demonstrations of the multifunction staring sensor suite capability to conduct wide area search, automated target detection, recognition, and long range identification for future scout, fire support, and air defense missions.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology
	PROJECT DK70

– Transition design, performance, and technical data for development of operational requirements and engineering development specifications for the future scout and cavalry system.

FY 2001 Planned Program: (continued)

- 4250 – Develop 640x480 uncooled focal plane array with increased sensitivity.
  – Complete design of low power electronics and power management which reduces power consumption by 60% compared to currently fielded systems such as the Thermal Weapon Sight.
  – Complete design of lightweight optics, electronic, and mechanical interfaces to enable the low power uncooled infrared sensor technology to be readily reconfigured for applications such as the individual soldier thermal weapons sight, objective crew served weapon, or Javelin antitank weapon.
- 1097 – Complete definition and development of hardware and software modules required to demonstrate the sensor-to-C4I interface architecture in a scout platform and mine detection platform.
  – Complete development of data/image compression technology and techniques required to provide sensor data over limited bandwidth communications links.
  – Conduct virtual experiments to evaluate and refine capability to provide seamless transmission and understanding of sensor information across multiple battlefield users.
  – Conduct analyses and define requirements to implement the sensor-to-C4I interface architecture in the prototype brigade intelligence, surveillance, and reconnaissance platform.

Total 17892

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

PROJECT: DK86

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DK86 Night Vision, Airborne Systems	7846	11779	14428	10419	9913	9935	10595	9391	Continuing	Continuing

Mission Description and Justification: This project develops and demonstrates surveillance, reconnaissance, and pilotage technology for Army airborne platforms. Specific technology efforts focus on improved night pilotage sensors, high resolution head's up displays, and automated obstacle warning technology to enhance the operational effectiveness and survivability of currently fielded and future attack, scout, cargo and utility helicopters. This technology will significantly enhance the survivability of Army aviation assets by permitting rotorcraft to fly at nap-of-the-earth altitudes and avoid obstacles in day/night/adverse weather conditions, and reduce exposure to air defense artillery, surveillance systems, and smart missiles. Advanced helicopter pilotage (AHP) demonstration will provide a high-quality dual-spectral pilotage sensor and the displays needed to provide this imagery to the pilot. An aerial scout sensor suite demonstration will evaluate airborne sensors for improved non-line-of-sight targeting for weapons systems in the rapid force projection initiative ACTD. An advanced integrated targeting suite (AITS) will demonstrate an affordable millimeter wave electrically scanned radar with fused electro-optical sensor processing to achieve automated detection, recognition, and identification at extended ranges for air platforms and could be applied to ground platforms. Advanced aviator's night vision goggles (AANVG) will demonstrate a lightweight wide FOV (40 x 100 deg) low cost panoramic night pilotage capability for the air warrior. Multi-mission, unmanned aerial vehicle (UAV) sensor ATD will demonstrate infrared and hyperspectral sensors to provide upgrade options for airborne surveillance applications, including future tactical and short range UAVs. The air/land enhanced reconnaissance and targeting (ALERT) ATD continues efforts to develop a robust, affordable aided target recognition (ATR) capability for scout and attack helicopters and will demonstrate search on-the-move aided target acquisition using a forward looking infrared (FLIR)/laser sensor suite for future aviation assets. Technology developed under this project is also directly applicable to the night flying requirements of the other services and Special Operations Command's rotary wing aircraft.

FY 1998 Accomplishments:

- 2475 – Completed helmet mounted display of fused near infrared and far infrared pilotage sensor data to provide a significant reduction in pilot cognitive and physical work load during high speed, nap of the earth flight operations.
  – Demonstrated wide field of view dual spectrum night pilotage system during real time flight maneuvers for user evaluation and feedback.
- 2400 – Completed integration of aerial scout sensor aircraft, completed upgrades to ground station aided target recognition processor; conducted performance testing and delivered to the Rapid Force Projection Initiative (RFPI) ACTD for aerial reconnaissance and targeting missions.
- 2971 – Collected target and background data in varying operational environments and developed search and target acquisition databases needed to establish the performance baseline for on-the-move air/land enhanced reconnaissance and targeting.

Total 7846

FY 1999 Planned Program:

- 3265 – Develop performance and design requirements for multi-mission electro-optic/infrared sensor payloads for tactical and short range unmanned aerial vehicles.
  – Complete design of high performance, lightweight staring infrared sensor for wide area reconnaissance, and precision targeting.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology
	PROJECT DK86

– Complete design of lightweight multispectral/hyperspectral payload for measurement and signature intelligence.

FY 1999 Planned Program: (continued)

- 8219 – Develop on-the-move multisensor aided target recognition algorithm that combines laser range mapping and laser target profile data with infrared imagery for automated air/land enhanced reconnaissance and targeting advance technology demonstration.
  – Complete modifications to forward looking infrared target acquisition sensor suite, and continue test-fix-test evaluation baseline for on-the-move target detection and recognition performance.
  – Modify baseline laser rangefinder/designator to provide the increased pulse repetition rates necessary to operate in range mapping and target profiling modes during high-speed dynamic flight missions.
  – Complete evaluations and establish baseline performance of ATR algorithm probability of detection, classification, recognition, identification, probability of false alarm/false target reports.
  – Perform constructive virtual simulations to optimize sensor suite moding, field of regard, and scan rates for varying flight mission profiles.
  – Develop man-in-the loop virtual simulations to evaluate operational effectiveness of reduced false alarm / false target reports, extended range performance, increased acquisition probabilities over baseline system performance.
  – Evaluate and modify ATR processing based on feedback from virtual experiments.
- 295 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 11779

FY 2000 Planned Program:

- 2245 – Define requirements for integrating advanced helmet mounted night vision technologies into the Army/Navy air warrior integrated system.
  – Provide technical support to the Air Force panoramic night vision goggle program and establish rotary wing unique requirements for evaluation of the technology.
  – Define joint Army and Air Force development and test program to provide advanced 100 degree panoramic goggle sensor for air warrior.
  – Develop preliminary design of modifications required to address integration issues among the panoramic goggle and the air warrior helmet, laser eye protection and nuclear, biological and chemical protective mask.
- 5200 – Complete development and fabrication of high performance staring electro-optic/infrared (EO/IR) and multi/hyperspectral modular sensor payloads.
  – Complete environmental testing for shock, vibration, temperature, altitude, etc. to ensure the EO/IR UAV payloads are ready for aircraft integration and flight tests.
  – Develop and test mechanical interface for rapid and simple “plug in/plug out” modularity, electrical interface to include cables, connectors, power, and informational interface to include datalinks, command and control, mission planning, and ground checkout.
  – Develop mechanical mockups to demonstrate rapid interchangeability between high performance EO/IR, multi/hyperspectral and radar sensor payloads on a tactical UAV platform.
  – Integrate on manned platform and conduct instrumented flight-testing under dynamic flight conditions to verify functionality of the payloads and down links.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology
	PROJECT DK86

- 4383 – Complete development and coding of algorithm modifications needed to achieve enhanced ATR acquisition capabilities at extended range, against obscured and defilade targets from both a hover and moving airborne platform.

FY 2000 Planned Program: (continued)

– Perform aircraft testbed system integration of multi-function laser with electro-optic target acquisition sensor for final airborne data collection trials and performance demonstrations

– Demonstrate rapid target insertion / algorithm training process for achieving automatic detection and cueing performance against new/emerging target threats.

- 2600 – Develop performance and design requirements for the next generation electronically scanned target acquisition radar for Army aviation. This new radar will utilize advance radar materials, designs and electronics to provide superior performance with reduced size, weight, cost and power consumption.

– Conduct trade-off analyses to establish size, weight, signature profile requirements, to define interfaces and modularity requirements, and develop data to support cost trade-offs for applying the electronically scanned radar technology to Comanche, Apache, and special operations rotary wing aircraft.

– Define requirements for an on-the-move FLIR/ targeting radar sensor fusion algorithms to improve aircraft survivability during reconnaissance and attack flight missions.

Total 14428

FY 2001 Planned Program:

- 2259 – Develop panoramic night vision sensor mockups for cockpit/equipment integration evaluations.

– Complete critical design and initiate fabrication of air warrior version of the panoramic night vision sensor package.

- 2000 – Integrate high performance electro-optic/infrared and multi/hyperspectral sensor payloads on a tactical UAV platform and conduct operational demonstration and user warfighting experiments to support military assessments.

– Develop and transition performance and technical design data to support final development of operational requirements and engineering development specifications.

- 2660 - Complete integration of air/land enhanced reconnaissance and targeting technologies with demonstration aircraft and conduct airborne flight evaluations to demonstrate increased operational benefits derived from multi-function laser and ATR algorithm enhancements when performing search on-the-move, acquiring targets in defilade or obscured, or at extended range.

– Develop and transition performance and technical design data to support technology insertions decision by individual platform managers (Comanche, Apache, and future scout cavalry vehicle).

- 3500 – Develop on-the-move FLIR/ targeting radar sensor fusion algorithms to improve aircraft survivability during reconnaissance and attack flight missions. Analyze mast mount antenna assembly (designed under PE 0603772A), develop mock-ups, collect multispectral signature profiles, and make design refinements to minimize impact to reduced signature aircraft.

– Develop and conduct man-in-the loop virtual simulations to optimize sensor suite moding, field of regard, and scan rates for varying flight mission profiles and surveillance/attack missions.

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Technology Development**	PE NUMBER AND TITLE **0603710A Night Vision Advanced Technology**

Total 10419

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

PROJECT: DK87

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DK87 Night Vision, Combat Vehicles	4603	0	0	0	0	0	0	0	0	4603

Mission Description and Justification: This project demonstrates target acquisition sensor technology to meet the stringent requirements of future combat vehicles. The target acquisition (TA) ATD is a sensor suite consisting of a second generation thermal imaging sight with automated wide area search, aided target recognition, low cost millimeter wave (MMW) ground radar, and a multifunction laser that will be demonstrated for future tank, cavalry, and scout vehicles. Multi-function staring sensor suite ATD will demonstrate an advance modular reconfigurable sensor suite that integrates on to multiple combat vehicles. Funding for this project in FY99 and beyond has been restructured to projects DK70 and DK86 to more accurately reflect mission applications.

FY 1998 Accomplishments:

- 3103 – Integrated a modified M1A2 commander's independent thermal viewer, multifunction laser, and high-speed gimbal scan with aided target detection, recognition, and identification for automated wide-area search target acquisition.
  – Integrated electro-optic target acquisition suite with a millimeter wave ground radar and demonstrated radar cueing and multisensor aided target search and acquisition for ground vehicles.
- 1500 – Defined multifunction staring sensor suite (MFS3) requirements and validated performance requirements through modeling and simulation.

Total 4603

FY 1999 Planned Program: Project not funded in FY 1999

FY 2000 Planned Program: Project not funded in FY 2000

FY 2001 Planned Program: Project not funded in FY 2001

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

PROJECT: DK89

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
DK89 Millimeter Wave Technology	0	3477	0	0	0	0	0	0	0	3477

Mission Description and Justification: The objective of this one year Congressional special interest project is to conduct passive millimeter wave imaging technology research which will be utilized to demonstrate an all-weather, mission enabling capability on a helicopter platform. Flight tests will be conducted to establish the feasibility of pilotage and targeting in adverse weather such as dense fog and medium rain. This program specifically addresses a Special Operations Forces high priority capability. Other potential applications for the completed system include seeing through closed doors and walls in military operations in urban terrain.

FY 1998 Accomplishments: This project not funded in FY 1998.

FY 1999 Planned Program:

- 3385 - Complete development of a passive millimeter wave-imaging camera compatible with UH-1 characteristics.
  - Complete integration of the PMMWI camera aboard a UH-1 and establish flight worthiness of the UH-1/PMMWI camera system.
  - Complete flight tests of the UH-1 mounted passive millimeter wave imaging camera in class III weather to demonstrate a new, mission enabling capability.
- 92 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3477

FY 2000 Planned Program: This project is not funded in FY 2000.

FY 2001 Planned Program: This project is not funded in FY 2001.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603728A Environmental Quality Technology Development PROJECT 002

COST (*In Thousands*)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
002 Environmental Compliance Technology	0	0	1337	1626	2727	1856	1454	687	Continuing	Continuing

A. Mission Description and Justification: The focus of this program is to conduct demonstrations to mature technology which will assist Army installations in becoming environmentally compatible without compromising readiness or training. This program will include technology demonstrations for: restoration of sites contaminated with toxic and/or hazardous materials 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 will include demonstrations of proof of technological feasibility and assessment of operability and producibility that could lead to a capability for Army use, including technology transition from the laboratory to operational use. No other program exists that is appropriate for this work. The program is supported by the Office of the Secretary of Defense's Technology Area Review and Assessment Process. This project supports Army efforts to demonstrate technology to improve the Army's ability to achieve environmental compliance at its installations and its rework and production facilities. Technology demonstrated within this project will focus on reducing 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 prevent pollution at installations, facilities operations, and to comply with the myriad of Federal, state, and host country regulations dealing with hazardous wastewater, air emissions, and solid wastes. The primary developing agency for this project is the U.S. Army Engineer Research and Development Center (ERDC).

FY 1998 Accomplishments: Project not funded in FY 1998

FY 1999 Planned Program: Project not funded in FY 1999

FY 2000 Planned Program:

- 626 - Begin technology demonstration of cost effective technologies to remove, characterize, and dispose of or reuse sources of Army-peculiar lead hazards (to be completed in FY03).
- 711 - Begin technology demonstration of hazardous air pollutant emission control technologies of Army unique pollutants (to be completed in FY05).

Total 1337

FY 2001 Planned Program:

- 905 - Continue technology demonstration of cost effective technologies to remove, characterize, and dispose of or reuse sources of lead hazards.
- 721 - Continue technology demonstration of hazardous air pollutant emission control technologies of Army unique pollutants.

Total 1626

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603728A Environmental Quality Technology Development

PROJECT: 002

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	0	0	0	0
Appropriated Value				
Adjustments to Appropriated Value				
a. Congressional General Reductions				
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1337	+1626
Current Budget Submit (FY 2000 / 2001 PB)	0	0	1337	1626

Change Summary Explanation: Funding – This PE/project was established in FY 2000 to fund environmental quality technology demonstrations. There is no other PE in budget activity three for environmental quality activities.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603734A Military Engineering Advanced Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	18922	15523	15881	5240	4758	2939	5053	5396	0	Continuing
DT08 Combat Engineering Systems	9147	2255	3774	5240	4758	2939	5053	5396	0	Continuing
DT12 Rapid Terrain Visualization	9775	13268	12107	0	0	0	0	0	0	50844

A. Mission Description and Justification: This program encompasses demonstrations of technologies that provide the capabilities required for the engineer and logistician to successfully plan, rehearse and execute missions in support of the commander and the force projection Army. Critical deficiencies exist in the Army's ability to rapidly acquire, update, maintain and distribute terrain data in support of both terrain and battlefield visualization; to apply physics-based reasoning to planning and executing mobility, counter-mobility, survivability, and general engineering missions; to conduct logistics-over-the-shore operations in adverse sea states; to establish in-transit visibility of materiel and supplies; and to manage logistics distribution and logistics automation. The demonstration projects in this program element focus on the technologies required to correct these critical deficiencies. Capabilities demonstrated will be applicable to missions at all echelons within the force structure during either combat operations or operations other than war. Demonstrations are integral components of Army Advanced Warfighting Experiments, Advanced Concept Technology Demonstrations, other Advanced Technology Demonstrations, and joint field training exercises. Emphasis is placed on rapid transition of technologies into Command and Control (C2) systems, combat/war models and simulations or simulators. This provides shared situational awareness, common representation of terrain and consistent predictions or assessments of mobility, counter-mobility, survivability, and logistics missions in the linkage of C2 systems, models, and simulations being developed by the Army to exploit information technologies. The work in this program element is consistent with the Army Science and Technology Master Plan, the Training and Doctrine Command (TRADOC) Battlefield Visualization Concept, the Office of the Deputy Chief of Staff, Operations (ODCSOPS) Battlefield Visualization Objectives, the Army Modernization Plan, and Project Reliance.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603734A Military Engineering Advanced Technology

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	19574	13564	15020	4906
Appropriated Value	20331	15564		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-757	-41		
b. SBIR / STTR	-490			
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions	-162			
Adjustments to Budget Years Since FY 1999 PB			+861	+334
Current Budget Submit (FY 2000 / 2001 PB)	18922	15523	15881	5240

Change Summary Explanation: Funding - FY 1999 – Appropriated value reflects Congressional add (+2000).

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603734A Military Engineering Advanced Technology

PROJECT: DT08

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DT08 Combat Engineering Systems	9147	2255	3774	5240	4758	2939	5053	5396	0	Continuing

Mission Description and Justification: This project will demonstrate, at full scale, a capability to conduct logistics-over-the-shore (LOTS) operations at sea-state 3; this will greatly increase LOTS throughput of equipment and supplies from ship to shore, and significantly reduce the time and materials required to establish linkages between LOTS sites and the inland transportation infrastructure. Present LOTS operations are limited to sea-state 2 or less; this is an unacceptable limitation to force projection. A complete engineering design of a full-scale Rapidly Installed Breakwater System (RIBS) will be developed based on detailed engineering analyses, and laboratory and ¼-scale field tests. A full-scale demonstration of RIBS that reduces waves conditions from the lower range of sea-state 4 by 50 percent will be performed. Evaluations of the full-scale deployability, transportability, mooring loads, structural integrity, and potential of RIBS for storm survival will be conducted. The capability to rapidly, and with minimum logistics burdens and reduced engineer equipment, stabilize beach sands and soft soils for roads, material storage areas, heliports, and other horizontal operating surfaces associated with LOTS operations will be demonstrated. The work is performed by the Waterways Experiment Station, Vicksburg, MS. Note: Sea-state is a measure of wave height and frequency of maximum wave energy.

FY 1998 Accomplishments:

- 1558 - Demonstrated mobility and survivability battlefield operating system software during Ulchi Focus Lens in Korea to verify worldwide planning capabilities.
- 5715 - Developed test plan, designed ocean-scale breakwater; and procured components and materials for 1Q99 field experiment; identified, evaluated, and selected geo-materials for sandy soil stabilization and surfacing.
  - Obtained laboratory data and designed field experiment to gather and analyze mooring system loads for RIBS.
- 1874 - Tele-engineering: demonstrated baseline capabilities for providing from CONUS to OCONUS assessments of bridge military load class, transportation network capability and throughput, flooding and river levels, and force vulnerability to vehicle bombs; established tele-engineering presence on existing communications networks.

Total 9147

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603734A Military Engineering Advanced Technology PROJECT DT08

FY 1999 Planned Program:

•	269	- Deploy ocean-scale, 400-foot long RIBS; analyze field experiment data; initial design of prototype RIBS.
		- Determine mooring requirements for Rapidly Installed Breakwater System (RIBS).
•	1927	- Exploration of selected geo-materials for soft soil (beach) stabilization and surfacing.
		- Develop plan for soft-soil stabilization field demonstration.
		- Development and test at 1/6 scale initial barge-RIBS design.
•	59	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs..
Total	2255	

FY 2000 Planned Program:

•	3275	- Complete engineering design for full-scale rapidly installed breakwaters based on detailed engineering analyses, laboratory tests, and ocean scale field tests; provide the capability to rapidly stabilize beach sands with minimum logistics burdens and reduced engineer equipment .
•	499	- Develop concept for a sandy beach field demonstration.
		- Field demonstration of soft-soil stabilization technology.
Total	3774	

FY 2001 Planned Program:

•	4097	- Deploy full-scale RIBS and mooring system at operational length (1000 ft).
	1143	- Provide plan, acquire materials for a sandy beach demonstration.
Total	5240	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603734A Military Engineering Advanced Technology

PROJECT: DT12

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
DT12 Rapid Terrain Visualization	9775	13268	12107	0	0	0	0	0	0	50844

Mission Description and Justification: This project will demonstrate the integration of critical battlefield visualization technologies in support of crisis response and force projection missions to enable the Joint Warfighter to successfully plan, rehearse and execute his mission. Digital Topographic Data (DTD) are the foundation for battlefield visualization and these data are not currently available for most areas where Force XXI units will operate. Methods for rapidly producing DTD to support military operations, particularly early entry, and the optimum resolution and format of digital terrain data for both current and notional systems need to be established. The Rapid Terrain Visualization (RTV) Advanced Concept Technology Demonstration (ACTD) will be conducted to demonstrate capabilities to rapidly collect source data and generate high resolution digital terrain databases to support crisis response and force projection operations within the timelines required by the joint force commander. The RTV ACTD will also demonstrate capabilities for the commander to integrate these terrain databases with current situation data, and manipulate and display the integrated databases to visualize the desired end state, and determine how to achieve his objectives. A capability for rapid collection of high-resolution (up to 1-meter grid spacing) digital terrain elevation data will be demonstrated, and imagery from aircraft and satellite platforms will be used to generate terrain feature data and map backgrounds. The RTV ACTD will provide and leave behind computer workstations and applications software to generate high resolution terrain databases to develop and evaluate courses of action using mission planning and embedded wargaming software, and to support mission rehearsals. This ACTD will also provide a tool for further exploration of emerging warfighting concepts and doctrine. The ACTD will leverage the Defense Advanced Research Projects Agency (DARPA) Battlefield Awareness and Data Dissemination (BADD) ACTD for data dissemination over the global broadcast system and tactical communications, and the Communications and Electronics Command (CECOM) Battlespace Command and Control (BC2) Advanced Technology Demonstration for workstations and applications software. This project is cooperatively executed with and will leverage work in progress by: the Topographic Engineering Center (TEC); National Imagery and Mapping Agency (NIMA); National Reconnaissance Office (NRO); Defense Airborne Reconnaissance Office (DARO) to include continuation of the Interferometric Synthetic Aperture Radar (IFSAR) work for FY00-01 in this PE as part of the Divestiture of DARO; and the Defense Modeling and Simulation Office (DMSO). This project is managed by the Joint Precision Strike Demonstration (JPSD) Program Office, Fort Belvoir, VA, Program Executive Officer, Intelligence, Electronic Warfare and Sensors (PEO-IEW&S), Fort Monmouth, NJ. Contractors include: Raytheon, Bedford, MA; SAIC, Rosslyn, VA; MRJ, Oakton, VA; TASC, McLean, VA; EO-IR Measurements, Spotsylvania, VA; Steven Myers and Associates, Vienna, VA; and MTC, Shrewsbury, NJ. Participating government laboratories include: Topographic Engineering Center, Alexandria, VA; Army Research Laboratory, Adelphi, MD; Communications and Electronics Research, Development and Engineering Center, Ft. Monmouth, NJ.

FY 1998 Accomplishments:

- 4717 - Conducted detailed technical and operational study to select optimum radar and platform for collection of high-resolution digital elevation data.
  - Merged linear and spatial feature data into a fully integrated data set using prototype battlefield visualization database generation software and generated tailored databases for terrain analysis workstations.
- 5058 - Demonstrated baseline semi-automated feature extraction capability using commercial satellite imagery.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603734A Military Engineering Advanced Technology
	PROJECT DT12

FY 1998 Accomplishments: (continued)

- Demonstrated prototype Rapid Terrain Visualization (RTV) systems in JPSD Integration Evaluation Center (IEC) and obtained data to evaluate measures of effectiveness.
- Participated in Division XXI AWE in support of III Corps and 101st Warfighting Experiment (WFX) in support of the XVIII Airborne Corps.
- Installed version 1.0 of semi-automated topographic data generation software at XVIII Airborne Corps testbed and III Corps topographic units.
- Received approval and acquired DeHavilland-7 platform.

Total 9775

FY1999 Planned Program:

- 6155 - Acquire and process high-resolution digital elevation data set and commercial satellite imagery in direct support of XVIII Airborne Corps Warfighter Exercises (WFXs).
- Exploit multi-spectral and radar imagery to accelerate the terrain feature extraction process using the prototype RTV database generation system.
- 7113 - Iteratively upgrade workstations and software at XVIII Airborne Corps and III Corps.
- Demonstrate RTV process in the IEC, including capabilities for rapid elevation data collection and semi-automated extraction of feature data.
- Extend selected RTV capabilities from XVIII Airborne Corps to selected III Corps elements for further user evaluation.
- Complete modifications to deHavilland-7 Aircraft, including installation and integration of RTV Interferometric Synthetic Aperture Radar (IFSAR) sensor and onboard processing capability.
- Conduct evaluation of sensor and products and collect "ground truth" for IFSAR data verification.

Total 13268

FY 2000 Planned Program:

- 6273 - Complete integration and testing of high-resolution elevation data collection capability on DASH-7 aircraft.
- Demonstrate integrated end-to-end RTV process.
- 3916 - Acquire and process digital terrain data using DASH-7 aircraft collection platform and commercial satellite sources in direct support of XVIII Airborne Corps WFXs.
- Extend upgrades and capabilities to topographic units within III Corps.
- 1918 - Complete upgrade of workstations and software to objective capability in the IEC and XVIII Airborne Corps and evaluate in WFX.

Total 12107

FY 2001 Planned Program: Project not funded in FY 2001.

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603772A Advanced Tactical Computer Science and Sensor Technology

COST (*In Thousands*)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	17602	18257	22610	19111	22213	23694	26179	27557	Continuing	Continuing
D101 Tactical Automation	11101	12951	16108	13421	15941	16887	18845	19858	Continuing	Continuing
D243 Sensors and Signal Processing	3628	5306	6502	5690	6272	6807	7334	7699	Continuing	Continuing
D281 Ground Combat Identification Demonstrations	2873	0	0	0	0	0	0	0	0	25865

A. Mission Description and Justification: This program element supports projects that provide advanced computer science and technology solutions to command and control (C2), data correlation, tactical surveillance, and combat identification problems. Specifically, this program addresses technologies to provide integrated battlefield situation awareness (SA), synchronization of combined arms forces, synchronization of joint forces, C2 on the move, correlation of intelligence data from airborne and space based sensors, battlefield combat identification (CI), point of engagement identification (ID) approaches to reduce fratricide for ground forces, unmanned air vehicle surveillance, and hostile weapons location. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. It is related to and fully coordinated with efforts in PE 0602783A (Computer and Software Technology), PE 0602782A (Command, Control and Communications Technology), PE 0603006A (Command, Control and Communications Advanced Technology), PE 0602709A (Night Vision Technology), PE 0603710A (Night Vision Advanced Technology), and PE 0602120A (Electronic Surveillance and Fuzing Technology) in accordance with the ongoing Reliance joint planning process.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	18886	18456	22411	21214
Appropriated Value	19970	18456		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-1084	-199		
b. SBIR / STTR	-439			
c. Omnibus or Other Above Threshold Reductions	-145			
d. Below Threshold Reprogramming	-700			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+199	-2103
Current Budget Submit (FY 2000/2001 PB)	17602	18257	22610	19111

Change Summary Explanation: Funding: FY2001 funding (-2103) reprogrammed to support other high priority requirements.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603772A Advanced Tactical Computer Science and Sensor Technology
	PROJECT D101

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D101 Tactical Automation	11101	12951	16108	13421	15941	16887	18845	19858	Continuing	Continuing

Mission Description and Justification: This is the Army's major science and technology program to provide the architecture and products to implement the digitized battlefield and establish information dominance for US ground forces. It develops advanced computer science and technology solutions to redress Army-unique command and control deficiencies in the area of combined arms operations. Specifically, this project addresses technology solutions for digital information transfer and display of horizontal battlefield situation awareness data, synchronization of combined and joint forces, command and control (C2) on the move, command and control for light forces, and platform C2. Key technologies utilized include: expert system and intelligent agent decision support technology, database and distributed database architecture development, data compression, man-machine interfacing, information filtering, advanced information display technology, digital terrain display and manipulation, and automated navigation/geopositioning. Major program goals include improved force synchronization and fratricide reduction through the development and display of a common battlefield view. The battlespace command and control (BC2) advanced technology demonstration (ATD) will apply technologies for common view of the battlefield to develop prototype software capabilities and architectures supporting the Army digital battle staff requirements for merging situation awareness and battle command with mission planning/rehearsal and battlefield visualization capabilities. Digital command, control and communications (C3) hardware and software technologies will be demonstrated that integrate rapid force projection hunter-and standoff killer elements in a manner that is compatible with Force XXI battlefield operating systems and army battle command system (ABCS) components. Tri-service interoperability and supporting information architecture will also be determined. The logistics command and control (Log C2) ATD will develop course of action analysis and support software tools for combat service support and operational commanders. Joint developer/user warfighting demonstrations will be conducted in conjunction with the Mounted, Dismounted, Battle Command, and Combat Service Support Battle Labs. Products will be transitioned to Program Executive Offices (PEOs) (Command, Control and Communications Systems (C3S), Aviation, etc.) for integration within their systems and subsequent fielding.

FY 1998 Accomplishments:

- 3638 – Integrated battlefield visualization tools in a composite digital terrain/enemy/friendly visualization display with embedded, linked combat information and conducted collaborative planning experiments within battle planning and visualization prototype.
- 2472 – Developed integrated battlefield visualization tools to improve real time integrated situation awareness, reduced timelines for collaborative planning and rehearsal, and streamlined decision support activities in support of the battlefield commander as demonstrated at the Division XXI Advanced Warfighting Experiment.
  – Developed automated courses of action (COAs) and support the analysis capabilities in accordance with the doctrinal military decision making process.
- 2511 – Demonstrated commander/staff battle planning and visualization workstation in Division XXI Advanced Warfighting Experiment.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603772A Advanced Tactical Computer Science and Sensor Technology
	PROJECT D101

FY 1998 Accomplishments: (continued)

– Provided C2 integration support for experiments and demonstrations including the Rapid Terrain Visualization Advanced Concept Technology Demonstration. (ACTD).
– Transitioned prototype mission planning tools to Maneuver Control System Block IV development.
- 2480 – Delivered the Light Digital Tactical Operations Center (LDTOC) for the Rapid Force Projection Initiative (RFPI) ACTD.
– Completed communications processor software for LDTOC and its simulator provided interface between live and virtual entities.
– Completed Distributed C2 (DC2) software for LDTOC and its simulator to provide all RFPI elements a common battlefield picture and unique displays and controls to the Hunter Sensor Suite operator.
– Trained user on LDTOC, DC2 software and communications processor software and supported RFPI ACTD field exercise.

Total 11101

FY 1999 Planned Program:

- 5073 – Define/demonstrate information and data flow requirements, command and control element interfaces, and transitional data requirements to provide faster, more accurate, more intuitive mission tailored information to the commander/staff at brigade, division and corps level.
- 3408 – Conduct modeling and simulation supporting critical event course of action analysis to streamline mission planning and rehearsal timelines and provide more rapid mission order execution.
- 4020 – Conduct systems architecture analyses for multi-echelon command and control functions in a Joint environment.
- 250 – Determine logistics operations planning criteria (LOPC) and combat service support (CSS) data requirements critical for the development of automatic decision support tools needed to reduce planning times for the Force XXI decision cycle.
- 200 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 12951

FY 2000 Planned Program:

- 5015 – Scale, tailor and expand visualization products/tools to joint level to provide faster, more accurate, more intuitive mission tailored information to the commander/staff at corps level.
- 3104 – Develop a human-in-the-loop simulation capability to provide real-time COA analysis and revision during its execution within a wargame simulation.
- 3820 – Demonstrate intelligent agents which monitor mission plans and alert commanders to significant variation in expectations or execution of the plan, thereby allowing repair/modification of mission plans and resynchronization of forces as required.
- 2171 – Demonstrate automated decision support software tool that enables combat commanders to plan weapon system crewing.
– Demonstrate enhanced logistics COA analysis capability for reduced planning time and increased number of operational scenarios evaluated.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603772A Advanced Tactical Computer Science and Sensor Technology
	PROJECT D101

FY 2000 Planned Program: (continued)

- 1998 – Develop the concept and preliminary architecture for a command post capable of highly mobile and on-the-move operation. Investigate DARPA command post of the future (CPoF) program technologies for applicability to Army command and control.

Total 16108

FY 2001 Planned Program:

- 4424 – Demonstrate deliberate course of action (COA) software with automatic alerts for rapid replanning.
  – Demonstrate decision support software that optimizes weapon system management based on current fuel, ammunition and major end item situational awareness to improve readiness and resource utilization.
- 7273 – Develop and integrate battlefield command and control information superiority technologies (e.g., information management, visualization, decision aids, human-computer interface, etc.) for highly mobile command posts. Select appropriate DARPA CPoF technologies to leverage to improve decision making and reduce staffing in the Army highly mobile command post.
- 1724 – Develop a common, collaborative command and control and intelligence battlespace visualization and course of action capability.

Total 13421

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603772A Advanced Tactical Computer Science and Sensor Technology
	PROJECT D243

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D243 Sensors and Signal Processing	3628	5306	6502	5690	6272	6807	7334	7699	Continuing	Continuing

Mission Description and Justification: This project provides for advanced development of advanced radar and signal processing technologies for reconnaissance, surveillance, target acquisition, counter battery, and navigation applications. Multi-mission common module unmanned aerial vehicle (UAV) sensors advanced technology demonstration (ATD) will demonstrate an interchangeable, lightweight, low cost synthetic aperture/moving target indicator radar and electro-optic/infrared sensor payload (being developed in PE 0603710A) to provide manned and tactical unmanned air vehicles with wide area, all weather surveillance capability. A new generation of ultra-wideband radar, jointly developed by the Army, DARPA, and Air Force, will provide foliage and ground penetrating technology for aerial surveillance and targeting. An electronically scanned radar will be demonstrated to provide army reconnaissance and attack helicopters with a highly reliable, affordable, multirole sensor for targeting, combat identification, and terrain avoidance.

FY 1998 Accomplishments:

- 3228 – Conducted requirements analysis for application of the multi-mission UAV sensors ATD compact moving target indicator (MTI)/synthetic aperture radar (SAR) sensor technology to future short and tactical UAVs, and airborne reconnaissance low/aerial common sensor for fixed wing aircraft..
  – Completed system level design of compact MTI/SAR sensor for tactical UAV applications.
  – Evaluated operational moding and tactical control station software alternatives.
  – Conducted timeline, error rate and bandwidth utilization analyses for sensor data downlink.
  – Completed trade-off and design analyses to identify common gimbal, processing, and data link components that will allow MTI/SAR and EO/IR sensors to be rapidly interchanged based on mission requirements.
  400 – Developed Army unique performance and aircraft integration requirements for joint service foliage penetrating (FOPEN) synthetic aperture radar (SAR) that will allow airborne surveillance platforms to detect targets concealed by foliage.

Total 3628

FY 1999 Planned Program:

- 3600 – Design and develop compact MTI/SAR transmitter and receiver components and lightweight composite antenna structure to meet payload weight and power consumption requirements of tactical UAV platform.
  – Develop operational moding and tactical control station simulation for user evaluation and design feedback.
  – Design and develop modular gimbal/payload housing assembly that will allow users to rapidly employ either MTI/SAR or EO/IR payloads to optimize surveillance performance for mission and weather conditions.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603772A Advanced Tactical Computer Science and Sensor Technology
	PROJECT D243

FY 1999 Planned Program: (continued)

- 1565 – Evaluate electromagnetic interference and compatibility of FOPEN SAR with army aircraft avionics to prevent interference with navigation and flight electronics.
  – Integrate SAR onto army aircraft to demonstrate the feasibility of using a military aircraft to perform FOPEN missions.
  – Integrate Ground Control and Display Station and demonstrate a functional ground processing facility to post process the SAR data and disseminate to users.

141 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5306

FY 2000 Planned Program:

- 4002 – Complete MTI/SAR sensor development, subsystem integration and perform laboratory bench testing to verify functionality.
  – Test sensor payloads under environmental extremes for shock, vibration, temperature, altitude, etc.
  – Develop and test mechanical interface for "plug in/plug out" modularity, electrical interface to include cables, connectors, power, etc, and informational interface to include datalinks, command and control, mission planning, and ground checkout.
  – Conduct instrumented flight testing under dynamic flight conditions to characterize MTI/SAR sensor performance in surveillance and targeting roles.
- 2500 – Conduct engineering flight tests to characterize the capabilities of the FOPEN SAR in detecting tactical targets hidden by foliage and/or camouflage cover.
  – Refine the algorithms to reduce false alarms to enhance the effectiveness of the automatic target detection and cueing in providing valid targets.
  – Conduct verification test to evaluate the achieved performance against the exit criteria and determine the readiness of a FOPEN SAR for participation in operational demonstration.

Total 6502

FY 2001 Planned Program:

- 3700 – Complete airborne testing of multimission UAV MTI/SAR sensor payload and data collection and verify performance through data analysis.
  – Participate in operational demos for military assessment of multifunctional sensor suite on tactical UAV.

	1990	- Evaluate ground post processing of FOPEN data with a goal of reducing the clutter false alarms by an order of magnitude such that the image analyst can effectively discriminate tactical targets embedded in heavy foliage. - Conduct user tests to demonstrate the real-time application of a FOPEN SAR to meet the need of an all weather detection of concealed threat targets. - Demonstrate/validate the concept of operation for using the FOPEN SAR to support the mission of potential users such as European Command, Southern Command, and Drug Enforcement Administration.
Total	5690	

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

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603772A Advanced Tactical Computer Science and Sensor Technology

PROJECT: D281

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D281 Ground Combat Identification Demonstrations	2873	0	0	0	0	0	0	0	0	25865

Mission Description and Justification: The objective of this project is to select, develop, and demonstrate techniques that minimize fratricide and increase combat effectiveness during surface-to-surface and air-to-surface engagements, and to demonstrate integration of advanced target identification (ID) and situation awareness (SA) capabilities into the Digitized, Joint battlefield environment and architecture. Selection of candidate approaches for technical and operational field evaluation are made based on results of architecture investigations for the combined arms battlefield. This Battlefield Combat Identification (BCID) advanced technology demonstration (ATD) serves as the foundation for the Joint advanced concept technology demonstration (ACTD) for air-to-surface and surface-to-surface combat ID (CID). The ACTD will utilize the Army's Task Force XXI digitized brigade advanced warfighting experiment (AWE) and other field experiments as a means to assess operational utility of these new capabilities. Information derived from these field experiments will support specification of follow-on engineering and manufacturing development (EMD) efforts.

FY 1998 Accomplishments:

- 2873 – Completed analysis of extended positional accuracy capabilities of Enhanced Battlefield Combat Identification System (E-BCIS) based system and other BCID ATD systems.
  – Completed SA through sight field demonstration to include E-BCIS, Appliqué and other acquisition and target ID systems.

Total 2873

FY 1999 Planned Program: Program not funded in FY 1999

FY 2000 Planned Program: Program not funded in FY 2000

FY 2001 Planned Program: Program not funded in FY 2001

THIS PAGE INTENTIONALLY LEFT BLANK

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0604280A Joint Tactical Radio PROJECT D152

COST *(In Thousands)*	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
D152 Joint Tactical Radio System*	0	10033	0	0	0	0	0	0	0	10033

*A FY 98 $15M Congressional Reprogramming into PE 0603280A, was approved December 1998.

A. Mission Description and Budget Item Justification: The Joint Tactical Radio System is a joint Research and Development program with the Army as the lead Service that will lead to the Services acquiring a family of affordable, scaleable, high-capacity, interoperable Line of Sight (LOS) and Beyond Line of Sight (BLOS) tactical radios. The singular functionality of current systems requires a commensurate number of unique discrete radio systems. These systems lack the connectivity and throughput capacity to support the required simultaneous networked voice, video, and data operations with low probability of intercept over multiple frequency bands. In addition, each current system requires significant allocation of space, weight, power, and cooling on weapons systems platforms, and has associated with it a costly logistics infrastructure. Therefore, a consolidated systems approach to provide substantial increase in capability and interoperability, and to provide overall cost savings mandate an approach like JTRS. JTRS activity in this program element creates the foundation for achieving network connectivity across the RF spectrum. This program element will provide an open standards architecture monitoring and compliance, a supporting certification infrastructure, the development of a set of software-based legacy tactical waveforms as well as a new wideband waveform which functions in networked environment and will operate on hardware that is built to JTRS architecture standards. Together, the architecture, the hardware, and the software will yield software programmable and hardware configurable digital radio systems that provide increased interoperability, flexibility and adaptability. The open standards based architecture will also provide the path for future hardware and software growth of delivered systems at minimal cost by allowing the Services to take advantage of advances in technology being realized in the commercial wireless communications marketplace. The JTR will provide the operational forces with an upgraded communications capability, for more effective battlespace management and interoperability among Command, Control, Communications, Computers and Intelligence (C4I) Systems supporting the warfighters' goal of realizing a fully digitized battlespace.

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	10000	15600	0	0
Appropriated Value	0	10100		
Adjustments to Appropriated Value				
a. Congressional General Reductions		-67		
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB				
Current Budget Submit (FY 2000 / 2001 PB)	0	10033	0	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0604280A Joint Tactical Radio
	PROJECT D152

Change Summary Explanation: A FY 98 $15M Congressional Reprogramming into PE 0603280A, was approved December 1998.

FY 1998 Accomplishments: FY 1998 efforts are funded under PE 0603280A.

FY 1999 Planned Program:

•	1323	Continue JTRS Technical Support
•	8047	Develop JTRS Architecture Building on a Baseline Definition Derived from the Previous Consortia Activities
•	397	JTRS Program Support
•	266	Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	10033	

FY 2000 Planned Program: Program is funded in Project D162, PE0604280A, Budget Activity 5..

FY 2001 Planned Program: Program is funded in Project D162., PE0604280A, Budget Activity 5.

THIS PAGE INTENTIONALLY LEFT BLANK

blank

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT	ADDRESS
3	DOD Compt, INV, Pentagon, Room 4B916, Washington, DC 20301-1100
1	DOD Compt, P&S, Pentagon, Room 3A862, Washington, DC 20301-1100
1	DOD Compt, MILCON, Pentagon, Room 3D841, Washington, DC 20301-1100
1	DOD Compt, Management Improvement, Pentagon, Room 1A658, Washington, DC 20301-1100
1	USD (Policy), Pentagon, Roo 4B926, Washington, DC 20301-2100
1	USD(A&T), Mailroom, Pentagon, Room 3D139, Washington, DC 20310
1	OSD, ATTN: DOT&E, Pentagon, Roo 3E318, Washington, DC 20301
1	ASD(C3I), Pentagon, Roo 3E209, Washington, DC 20301
1	ASD(IS), Pentagon, Roo 4B938, Washington, DC 20301
1	ASD(LA), Pentagon, Roo 3D918, Washington, DC 20301
1	USD(P&R), Room 3C980, Washington, DC 20301-4000
1	ASD(RA), Pentagon, Roo 2D528, Washington, DC 20301
1	ASD (PA&E), Pentagon, Roo 2D278, Washington, DC 20301
1	ASD(PA), Pentagon, Room 2D278, Washington, DC 20301
1	JCS(J-8), Pentagon, Room 1E963, Washington, DC 20301
*	HQDA, (SAUS-OR), Pentagon, Roo 2E600, Washington, DC 20310
*	HQDA (SAILE), Pentagon, Roo 2E614, Washington, DC 20310
1	HQDA (SAFM-BUI), Pentagon, Room 3C652, Washington, DC 20310-0109
2	HQDA (SAFM-BUI-A), Pentagon, Room 2E673, Washington, DC 20310-0109
8	HQDA (SAFM-BUI-A), Suite 11500, 2511 South Jefferson Davis Highway, Arlington, 22202-3925

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT	ADDRESS
*	HQDA (SARD-DEP), Pentagon, Roo 2E673, Washington, DC 20310
1	HQDA (SARD-TS), Suite 9000, 2511 South Jefferson Davis Highway, Arlington, VA 22202
*	HQDA (SAFM-CAZ-A), 5611 Columbia Pike, Falls Church, VA 22041-5050
*	HQDA (SFIS-API), Hoffman 1, Room 1012, Alexandria, VA 22331-0302
*	HQDA (DACS-DPD), Pentagon, Room 3C738, Washington, DC 20310
*	HQDA (DACS-DP), Pentagon, Roo 1C460, Washington, DC 20310
*	HQDA (SAIS-PPG), Pentagon, Roo 1D679, Washington, DC 20310
*	HQDA (DACS-DP), Pentagon, Roo 3C747, Washington, DC 20310
*	HQDA (DACS-DMC), Pentagon, Roo 3D631, Washington, DC 20310
*	HQDA (DACS-TE), Pentagon, Roo 3C571, Washington, DC 20310
*	HQDA (DAIM-ZR), Pentagon, Roo 2B683, Washington, DC 20310
*	HQDA (DAMI-ZXM), Pentagon, Roo 2D474, Washington, DC 20310
*	HQDA (DAMI-PBB), Pentagon, Roo 2E477, Washington, DC 20310
*	HQDA (DAPE-ZXO), Pentagon, Roo 2D735, Washington, DC 20310
*	HQDA (DALO-RMP), Pentagon, Roo 1E565, Washington, DC 20310
*	HQDA (DALO-Z), Pentagon, Roo 3E560, Washington, DC 20310
*	HQDA (DAMO-ZR), Pentagon, Roo 3D526, Washington, DC 20310
*	HQDA (DAMO-FDR), Pentagon, Roo 2D570, Washington, DC 20310
*	HQDA (DAAR-CO), Pentagon, Roo 1D432, Washington, DC 20310
*	HQDA (NGB-ZA), Pentagon, Roo 2E394, Washington, DC 20310

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT	ADDRESS
*	HQDA (DASG-ZA), 5111 Leesburg Pike , Room 638, Falls Church, VA 22041-3258
*	HQDA (DASG-RMZ), 5111 Leesburg Pike, Room 554, Falls Church, VA 22041-3258
*	HQDA (DASG-RDZ), Pentagon, Room 3E368, Washington, DC 20310-2300
*	HQDA (DAIM-ED), Pentagon, Room 1E682, Washington, DC 20310
*	HQDA (DAIM) Pentagon, Roo 1E665, Washington, DC 20310
*	HQDA (SAPA), Pentagon, Roo 2E641, Washington, DC 20310
*	HQDA (CSSD-RM-W), P.O. Box 15280, Arlington, VA 22215-0150
*	HQDA (SAAG-PRP), Room 1309, 3101 Park Center Drive, Alexandria, VA 22302-1596
*	HQDA (DAMH-ZB), Pulaski Bldg, Room 4229, 20 Massachusetts Avenue, Washington, DC 20314
*	US Army Cost And Economic Analysis Center, ATTN: SFFM-CA-PI, 5611 Columbia Pike, Falls Church, VA 22041-5050
*	BMDO/RM, Pentagon, Room 1E1037, Washington, DC 20310
*	HQDA, (JDRS-PBD), Pentagon, Room 1E610, Washington, DC 20310
*	HQ, PACOM, R&D Requirements (J531), BOX 15, USPACOM Staff, Camp H.M. Smith, HI, 96861
*	Commander, US Army Int lligence and Security Command, ATTN: IARM-PB, Fort Belvoir, VA 22060-5370
*	Commander, US Army Nuclear and Chemical Agency, ATTN: MONA-OPS, Bldg 2073, Backlick Road, Springfield, VA 22150
*	Commander, US Army Medical R&D Command, ATTN: SGRD-RMC, Fort Detrick, Frederick, MD 21701-5012
*	Commander, US Army Medical R&D Command, ATTN: SGRD-PR, Fort Detrick, Frederick, MD 21701-5012
*	Commander, US Army Training and Doctrine Command, ATTN: ATCD-E, Fort Monroe, VA 23651-5000
*	CMDT, Army Field Artillery School, ATTN: ATSF-CSI-P, ATSF-CBL, Ft. Sill, OK 73503-5600
*	CDR, Army Aviation Ctr & Ft. Rucker, ATTN: ATZS-CDI, Ft. Rucker, AL 36362-5000

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT	ADDRESS
*	CDR, Army Intelligence Ctr and FT. Huachucha, ATTN: ATZS-CDI-I, ATZS-CDT, Ft. Huachucha, AZ 85613-7000
*	CMDT, U.S. Army Signal Ctr, ATTN: ATZH-CDM, ATZH-BLT, Ft. Gordan, GA 30905-5000
*	Force Design Directorate, ATTN: ATCD-F, 415 Sherman Ave., Ft. Leavenworth, KS 66027-5000
*	CDR, USACHCS, ATTN: ATSC-CD, Ft. Monmouth, NJ 07703-5612
*	CDR, U.S. Army Medical Center & School, ATTN: HSMC-FCM, Ft. Sam Houston, TX 78234
*	CMDT, U.S. Army Air Defense Artillery School, ATTN; ATSA-CDM, Ft. Bliss , TX 79916
*	CMDT, U.S. Army Infantry School, ATTN: ATSH-IWC, ATSH-MLS, Ft. Benning, GA 31905-5400
*	CMDT, U.S. Army Armor School, ATTN: ATZK-CD-ML, ATZK-MW, Ft. Knox, KY 40121-5200
*	CMDT, U.S. Army Engineer School, ATTN: ATSE-CD-M, Ft. Leonard Wood, MO 65473-5000
*	CMDT, U.S. Army Chemical School, ATTN: ATZN-CM-CS, Ft. McClellan, AL 36205-5020
*	CMDT, U.S. Army Military Police School, ATTN: ATZN-MP-CM, Ft. McClellan, AL 36205-5020
*	Commander, US Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-MB, 5001 Eisenhower Avenue, Alexandria, VA 22333-5600
*	Commander, US Army Operational Test and Evaluation Command, ATTN: CSTE-RMZ, Park Center IV, 4501 Ford Avenue, Alexandria, VA 22302-1458
*	Commander, US Army Materiel Command, ATTN: AMCRD-AB, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001
*	Commander, US Army Materiel Command, ATTN: AMCAE-P, 5001 Eisenhower Avenue, Alexandria, VA 22333
*	Commander, US Army Materiel Command, ATTN: AMCAQ-B-TILO, 5001 Eisenhower Avenue, Alexandria, VA 22333
*	Commander, US Army Communications-Electronics Command, ATTN: AMSEL-CG, Ft. Monmouth, NJ 07703-5000
*	Commander, US Army Communication-Electronics Command, ATTN: AMSEL-ACSB-BT, Ft. Monmouth, NJ 07703-5008
*	Commander, US Army Missile Command, ATTN: AMSMI-AS (Library), Bldg 5250, RMC-147, Redstone Arsenal, AL 35898-5000

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT	ADDRESS
*	Commander, US Army Test and Evaluation Command, ATTN: AMSTE-RM, Aberdeen Proving Ground, MD 21005-5055
*	Commander, US Army CECOM, Technical Industrial Liaison Office, ATTN: AMSEL-AC-SP-BL (Sandra Vermont), Ft. Monmouth, NJ 07703-5008
*	Commander, US Army Tank-Automotive Command, ATTN: AMSTA-CG, Warren, MI 48397-5000
*	Commander, US Army Laboratory Command, ATTN: AMSLC-CG, Adelphi, MD 20783-1145
*	Commander, US Army Armament Research, Development and Engineering Center, ATTN: SMCAR-CO, Dover, NJ 07806-5000
*	Commander, Environmental Center, ATTN: SFIM-AEC-RM, Edgewood Area, Aberdeen Proving Ground, MD 21010-5055
*	Commander, US Army Materiel Systems Analysis Activity, ATTN: AMXSY-PB, Aberdeen Proving Ground, MD 21005-5071
*	Commander, US Army Chemical, Biological and Defense Command, ATTN: AMSCB-RR, Aberdeen Proving Ground, MD 21010-5423
*	Commander, US Army Chemical, Biological and Defense Command, ATTN: SCBRD-ASA, Aberdeen Proving Ground, MD 21010-5423
*	Commander, S Army Chemical, Biological and Defense Command, ATTN: AMSCB-EO, Aberdeen Proving Ground, MD 21010-5423
*	Commander, US Army Aviation and Troop Command, ATTN: AMSAT-D-C, 4300 Goodfellow Blvd, St. Louis, MO 63120-1798
*	Program Manager, Instrumentation, Targets and Threat Simulators, ATTN: AMCPM-ITTS, 12350 Research Parkway, Orlando, FL 32826
*	Program Manager, Tank Main Armament Systems, ATTN: AMCPM-TMD PMD, Picatinny Arsenal NJ 07806-5000
*	Program Executive Officer, Missile Defense, ATTN: SF E-MD-DP-P, Building 5250, Redstone Arsenal, Alabama 35898-5750
*	Program Executive Officer, Field Artillery Systems, ATTN: SFAE-FAS, Building 171, Picatinny Arsenal, Picatinny, NJ 07806-5000
*	Program Executive Officer, Armored Systems Modernization, ATTN: SFAE-HFM-P, Warren, MI 48397-5000
*	Program Executive Officer, Aviation, ATTN: SFAE-AV, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798
*	Program Executive Officer, Tactical Wheeled Vehicles, ATTN: SFAE-TWV, Warren, MI 48397-5000
*	Program Executive Officer, Command and Control Systems, ATTN: SFAE-CC-PMO, Ft. Monmouth, NJ 07703-5000

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT	ADDRESS
*	Program Executive Officer, Communication Systems, ATTN: SFAE-COM, Ft. Monmouth, NJ 07703-5000
*	Program Executive Officer, Tactical Missiles, ATTN: SFAE-MSL, Redstone Arsenal, AL 35898-8000
*	Program Executive Officer, Intelligence and Electronic Warfare, ATTN: SFAE-IEW-BM, Ft. Monmouth, NJ 07703
*	Commander, US Army Space and Strategic Defense Command, ATTN: CSSD-RM-BP, P.O. Box 1500, Huntsville, L 35807-3801
*	Commander, US Army Corps of Engineers, ATTN: CERD-L, Washington, DC 20314
*	Commander, US Army Force Integration Support Agency, ATTN: MOFI-TRED-O, Building 2588, Fort Belvoir, VA 22060-5587
*	Commander, 902d MI Group, ATTN: IAGPA-OPOP , Ft. Meade, MD 20755-5910
*	Commander, HQ US Army Missile & Space Intelligence Center, ATTN: AIAMS-YCC, Redstone Arsenal, AL 35898-5000
*	Commander, US Army Countermeasures/Counter Counter Measures Center, ATTN: AMX-CM-RF, 2800 Powder Mill Rd, Adelpi, MD 20783
*	Commander, US Army Belvoir Research, Development & Engineering Center, ATTN: STRBE-Z, Ft. Belvoir, VA 22060-5606
*	Commander, US Army Research Office, ATTN: SLCRO-AO (Security Officer), P.O. Box 12211, Research Triangle Park, NC 27709
*	Inspector General, ATTN: A&IM/FMD, 400 Army-Navy Drive Arlington, VA 22202-2884
*	HQ USAF/FMBMC, Pentagon, Room 5C129, Washington, DC 20330-5012
*	HQ US Marine Corps, Deputy Chief of Staff for RD&S, Code (MC-RDP-30), Washington, DC 20380
*	Commandant, US Army War College, ATTN: Library, Carlisle Barracks, PA 17013-5050
*	Defense Advanced Research Projects Agency, ATTN: Comptroller, 3701 North Fairfax Drive, Arlington, VA 22203-1714
*	Institute for Defense Analyses, 1801 North Beauregard Street, Alexandria, VA 22311
*	Headquarters, National Aeronautical and Space Administration, Code ID, ATTN: Deputy DOD Affairs, Washington, DC 20546
*	Pentagon Library, ATTN: Army Studies, Room 1A518, Washington, DC 20310
*	Director, Defense Finance and Accounting Service-Indianapolis Center, ATTN: DFAS-I-PA, Indianapolis, IN 46249

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT	ADDRESS
*	Defense Technical Information Center (DTIC), ATTN: Ms. Mawby, Ft. Belvoir Headquarters Complex (FBHC), Suite 0944 8725 John J. Kingman Road, , Ft. Belvoir, VA 22060-6220
*	Defense Technical Information Center (DTIC), ATTN: OCC, Ft. Belvoir Headquarters Complex (FBHC), Suite 0928, 8725 John J. Kingman Road, Ft. Belvoir, VA 22060-6220
*	National Technical Information Service (NTIS), ATTN: Military Publications, 5285 Port Royal Road, Springfield, VA 22161
	HAND DELIVERY
1	DOD(C)(CFO), Room 1B728
11	SAFM-BUL, Room 3A652
9	SAFM-BUC-F, Room 3B663
*	SAFM-BUC-I, Room 3A674
*	SAFM-RB, Room 3A720
27	SALL, Room 2C638
77	Total Print

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**

APPENDIX A

RDT&E CONGRESSIONAL DESCRIPTIVE SUMMARIES MAILING LIST

PRINT **ADDRESS**

Any changes to this distribution list should be provided to HQDA (SAFM-BUI-A), Washington, DC 20310

***Distributed electronically – accessed via Office, Assistant Secretary of the Army (Financial Management and Comptroller) Worldwide Web Site (http:\\www.ASAFM.army.mil\)**