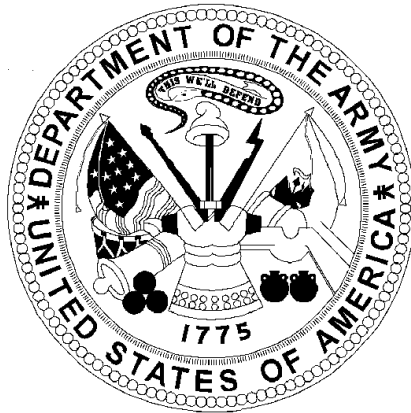


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Supporting Data for the FY 2002 Amended President's Budget Submitted  
to Congress – July 2001

**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)

**VOLUME I**

**UNCLASSIFIED**

**UNCLASSIFIED**

**DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS  
OF THE  
RESEARCH, DEVELOPMENT, TEST AND  
EVALUATION, ARMY  
FY 2002  
JULY 2001**

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

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

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## **Unit Set Fielding**

### **Notification**

The Army is committed to displaying future budget requests in Unit Set Fielding format. We will move toward this type of display beginning with our FY03 budget request.

The display of Unit Set Fielding will define a capability vice a piece of equipment.

### **Unit Set Fielding Definition**

Unit Set Fielding (USF) is the process that modernizes and transforms the Army **by unit sets** primarily at brigade and division levels. The USF schedule synchronizes the fielding of new and upgraded systems, along with supporting enablers, to units in specified windows of generally 6 months per brigade. The intent of this process is to field systems and enablers in sets to provide increased unit operational capability that supports the Army Vision and priorities established by the Army. This approach shifts the focus away from development and fielding of individual systems and to integrated combat capabilities. In order to effectively accomplish USF, the scope of synchronization extends to encompass requirements for manning units, training those units, sustaining those units, and includes installation requirements in support of unit requirements. USF is fully integrated into the Army Transformation Campaign Plan and is clearly the most effective means to synchronize the development and fielding of interim brigades and the objective force of the future.

The Army will work with Congress as we develop Unit Set Fielding displays to assure all required information is included.

### **FY 2000 Footnote**

FY 2000 dollars for the R-1 and R-2 do not match due to a disconnect in the databases.

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**FY 2002/2003 RDT&E, ARMY  
PROGRAM ELEMENT DESCRIPTIVE SUMMARIES**

**INTRODUCTION AND EXPLANATION OF CONTENTS**

**1. General.** The purpose of this document is to provide summary information concerning the Army Research, Development, Test and Evaluation, Army program. The Descriptive Summaries are comprised of R-2 (Army RDT&E Budget Item Justification – Program Element level), R-2A (Army RDT&E Budget Item Justification – project level) and R-3 (Army RDT&E Cost Analysis) Exhibits, which provide narrative information on all RDT&E program elements and projects for the FY 2000, 2001, 2002 and 2003 time period.

**2. Relationship of the FY 2002/2003 Budget Submission to the FY 2001 Budget Approved to Congress.** This paragraph provides a list of program elements restructured, transitioned, or established to provide specific program identification.

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

<b><u>OLD PE/PROJECT</u></b>	<b><u>NEW PROJECT TITLE</u></b>	<b><u>NEW PE/PROJECT</u></b>
0208010A/107	Joint Network Management System	0604783A/363
0305204A/114	Advanced Payload Development & Support	0305204A/11A
0601104A/H50 and H54	Power & Energy Collaborative Tech Alliances (CTAs)	0601104/J09
0603005A/440	Future Combat Systems (FCS)	0603005A/53G
0604270A/665	Environmental Restoration Technology	0603728A/03E
0604715A/396	Intelligence Simulation System	0604742A/361
0604715A/396	Warfighter Simulation	0604742A/362
0604739A/702	Integrated Broadcast Service (JMIP/DISTP)	0603850A/472
0604766A/909	Tactical Surveillance Systems (TIARA)	0603766A/907
0604818A/C34	Centralized Technical Support Facility	0604818A/C29
0605712A/987	Operational Testing Instrumentation Development	0605602A/62B
0605712A/987	Modeling and Simulation Instrumentation	0605602A/62C
0605898A/M65	SMDC – Reimb Manpower	0605898A/R02
Transfer from OSD	Alliance Executive Development and Integration	0604738A/J11

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**B. FY 2002/2003 Developmental Transitions.**

<b><u>FROM</u></b> <b><u>PE/PROJECT</u></b>	<b><u>PROJECT TITLE</u></b>	<b><u>TO</u></b> <b><u>PE/PROJECT</u></b>
0603774A/131	DTSP Development (TIARA)	0604270A/L21
0604710A/L69	Apache 2 <sup>nd</sup> Generation FLIR	0203774A/508

**C. Establishment of New FY 2002 /2003 Program Elements/Projects.** There are no major system new starts. Minor new initiatives for FY 2002, in addition to Congressionally directed initiatives for FY 2001, are shown below with asterisks. The remaining programs listed are outyear initiatives or restructures beyond FY 2001 or were previously funded from other Defense appropriations.

<b><u>TITLE</u></b>	<b><u>PE/PROJECT</u></b>
Apache Advanced Rotor and Drive System	0203744A/50A*
TOW Bunker Buster	0203802A/33A
Counter Terrorism Research	0601102A/T51*
Display Performance & Environmental Evaluation	0601102A/T55*
Science-based Regulatory Compliance Study	0601104A/H7A*
Advanced Materials Processing	0602105A/H7B*
Amorphous Metal Kinetic Energy Penetrator	0602105A/H7C*
Multiple Intelligence Remoted Sensor System	0602270A/91F*
Miniature Detection Devices & Analysis Methods	0602307A/04G*
Zeus Laser Ordnance Neutralization	0602307A/04H*
Voice Interactive Device	0602601A/HH8*
Hybrid Electric HMMWV	0602601A/T26*
Weapons & Munitions Tech Program Initiative	0602624A/H1A*
Environmental Cleanup at Porta Bella	0602720A/F31*
Environmental Quality Technology	0602720A/F35*
Army Heavy Metals Office	0602720A/F36*
Proton Exchange Membrane Fuel Cell	0602720A/F37*
DoD Fuel Cell Test and Evaluation Center	0602784A/T52*
Thermoelectric Power Generation for Military Apps	0602784A/T53*

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C. Continuation of Establishment of New FY 2002 /2003 Program Elements/Projects.

<u>TITLE</u>	<u>PE/PROJECT</u>
Emergency Hypothermia	0602787A/96A*
Real-time Heart Rate Variability Technology	0602787A/96B*
Biosensor Research	0603002A/97A*
Blood Safety	0603002A/97B*
Cancer Center of Excellence	0603002A/97C*
Center for Aging Eye	0603002A/97D*
Center for Prostate Disease Research	0603002A/97E*
Chronic Disease Management	0603002A/97F*
Chronic Fatigue	0603002A/97G*
Clinical Assessment Recording Environment	0603002A/97H*
DREAMS	0603002A/97I*
Echocardiogram	0603002A/97J*
Functional Magnetic Resonance Imaging	0603002A/97K*
Integrative Medicine Distance Learning Program	0603002A/97L*
Ligament Healing	0603002A/97M*
Lung Cancer Detection	0603002A/97N*
Lung Cancer Research	0603002A/97O*
Remote Acoustic Hemostassis	0603002A/97P*
Micro Positron Emission Tomography	0603002A/97Q*
Molecular and Cellular Bioengineering Research	0603002A/97R*
Molecular Genetics and Musculoskeletal Research	0603002A/97S*
Neurotoxin Exposure Treatment	0603002A/97T*
Ocular Fatigue Measurement	0603002A/97U*
Polynitroxilated Hemoglobin	0603002A/97V*
SEATreat Cancer Technology	0603002A/97W*
Synchrotron-based Scanning Research	0603002A/97X*
Virtual Retinal Display Technology	0603002A/97Y*
Tafenoquine Antimalarial Agent	0603002A/97Z*
Artificial Hip Volumetrically Controlled Mfg	0603002A/98A*
Fuel Cell Aux Power Units for Line Haul Trucks	0603005A/53B*
National Automotive Center & University Innovative Rsch	0603005A/53C*
National Automotive Center & Warfighting Battle Labs	0603005A/53D*

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C. Continuation of Establishment of New FY 2002 /2003 Program Elements/Projects.

<u>TITLE</u>	<u>PE/PROJECT</u>
IMPACT Truck Program	0603005A/53E*
NAC Standard Exchange of Product Model Data	0603005AS/53F*
Intelligence Analysis Advanced Tool Set	0603006A/59A*
Big Crow Program Office Support	0603006A/59B*
Army Training Support Center	0603007A/79A*
Multiple Intelligence Remote Sensor System	0603270A/K19*
Army Air and Missile Defense	0603308A/99A*
Starstreak/Stinger Live Fire Test	0603313A/713*
Target Defeating System	0603627A/E78
Trajectory Correctable Munition	0603639A/64A*
Corrosion Measurement and Control	0603728A/03F*
Commercialization of Tech to Lower Defense Costs	0603779A/04F*
WIN-Tactical-Dem/Val	0603782A/355
Integrated Broadcast Service (JMIP/DISTP)	0603850A/472
Medium Extended Air Defense System (MEADS)	0603869A/01B
Ground Common Missile	0604329A/01A
Target Defeating System	0604609A/198
Engineer Vehicle Upgrades	0604649A/G29*
Alliance Executive Development & Integration	0604738A/J11
Joint Network Management System	0604783A/363
Patriot Advanced Capability (PAC) – 3	0604865A/01C
Big Crow Support	0605601A/F38
Transportation Benefit Program	0605801A/M77*
Life Cycle Pilot Process	0605805A/859*
Fuze Technology Integration	0605805A/862*

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**D. FY 2002/2003 programs for which funding was shown in the FY 2001 President's Budget Submit  
(February 2000), but which are no longer funded.**

<b><u>PE/PROJECT</u></b>	<b><u>TITLE</u></b>	<b><u>BRIEF EXPLANATION</u></b>
0203801A/038	Avenger PIP	Reprogrammed for Higher Priorities
0303142A/559	Auto Com Mgt Sy (ACMS)	Program Completed
0303142A/561	Mil Indiv Comm (MIC)	Program Completed
0602308A/C99	Advanced Concepts and Tech II (ACT II)	Program Terminated
0602789A/880	Army AI Tech	Program Terminated
0604641A/E47	TUAV	Program Terminated
0604710A/L74	LRAS3	Program Transitions to Sustainment
0604778A/168	NAVSTAR GPS Equip	Program Completed
0604805A/098	Tac Radio Accessories	Program Completed
0604814A/644	Generic SADARM ED	Program Terminated
0604817A/482	Ground CID (BCIS)	Program Transitions to Production
0708045A/E32	COSSI	Program Terminated

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

0203735A/DC64	0603009A
0203808A	0603017A
0301359A	0603020A
0602104A	0603122A
0602122A	0603322A
0602601A/AC84	0603710A/DC65/ DC67
0602786A/AC60	0603851A
0603005A/DC66	0604328A



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Department of the Army  
FY 2002 RDT&E Program

Exhibit R-1

Summary

02-Jul-2001

Summary Recap of Budget Activities	Thousands of Dollars		
	FY 2000	FY 2001	FY 2002
Basic research	201,393	210,292	222,243
Applied Research	789,665	827,331	689,427
Advanced technology development	718,636	815,276	667,294
Demonstration/validation	507,215	931,778	863,445
Engineering and manufacturing development	1,523,081	1,857,550	2,339,146
Management support	854,470	742,750	756,475
Operational system development	719,527	894,915	1,155,890
Total RDT&E, Army	5,313,987	6,279,892	6,693,920

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 Department of the Army  
 FY 2002 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

02-Jul-2001

Line No	Program Element Number	Act	Item	Thousands of Dollars		
				FY 2000	FY 2001	FY 2002
Basic research						
1	0601101A	01	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	13,800	14,326	14,815
2	0601102A	01	DEFENSE RESEARCH SCIENCES	122,998	136,650	138,281
3	0601104A	01	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	64,595	59,316	69,147
Total: Basic research				201,393	210,292	222,243
Applied Research						
4	0602104A	02	TRACTOR ROSE	6,739	0	0
5	0602105A	02	MATERIALS TECHNOLOGY	15,016	27,304	13,794
6	0602120A	02	SENSORS AND ELECTRONIC SURVIVABILITY	22,885	23,008	25,797
7	0602122A	02	TRACTOR HIP	9,173	7,159	7,741
8	0602211A	02	AVIATION TECHNOLOGY	29,096	30,794	49,265
9	0602270A	02	EW TECHNOLOGY	16,545	22,007	17,449
10	0602303A	02	MISSILE TECHNOLOGY	53,216	70,035	40,112
11	0602307A	02	ADVANCED WEAPONS TECHNOLOGY	3,984	6,632	19,043
12	0602308A	02	ADVANCED CONCEPTS AND SIMULATION	32,518	36,144	20,579
13	0602601A	02	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	57,452	88,274	82,441
14	0602618A	02	BALLISTICS TECHNOLOGY	41,011	53,258	61,502
15	0602622A	02	CHEMICAL, SMOKE AND EQUIPMENT DEFEATING TECHNOLOGY	4,524	3,497	3,561
16	0602623A	02	JOINT SERVICE SMALL ARMS PROGRAM	5,048	5,365	5,611
17	0602624A	02	WEAPONS AND MUNITIONS TECHNOLOGY	35,574	47,817	35,549
18	0602705A	02	ELECTRONICS AND ELECTRONIC DEVICES	35,133	40,891	27,819
19	0602709A	02	NIGHT VISION TECHNOLOGY	22,641	23,746	20,598
20	0602712A	02	COUNTERMINE SYSTEMS	14,992	17,721	16,689
21	0602716A	02	HUMAN FACTORS ENGINEERING TECHNOLOGY	19,350	18,119	16,466
22	0602720A	02	ENVIRONMENTAL QUALITY TECHNOLOGY	76,597	60,434	16,150
23	0602782A	02	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	19,101	23,101	24,342
24	0602783A	02	COMPUTER AND SOFTWARE TECHNOLOGY	5,121	3,950	6,154
25	0602784A	02	MILITARY ENGINEERING TECHNOLOGY	46,697	55,332	42,850

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 Department of the Army  
 FY 2002 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

02-Jul-2001

Line No	Program Element Number	Act	Item	Thousands of Dollars		
				FY 2000	FY 2001	FY 2002
26	0602785A	02	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	11,723	11,759	16,315
27	0602786A	02	LOGISTICS TECHNOLOGY	25,649	27,901	27,061
28	0602787A	02	MEDICAL TECHNOLOGY	169,283	111,696	82,494
29	0602789A	02	ARMY ARTIFICIAL INTELLIGENCE TECHNOLOGY	1,228	1,326	0
30	0602805A	02	DUAL USE SCIENCE AND TECHNOLOGY	9,369	10,061	10,045
Total: Applied Research				789,665	827,331	689,427
Advanced technology development						
31	0603001A	03	WARFIGHTER ADVANCED TECHNOLOGY	36,847	21,768	60,332
32	0603002A	03	MEDICAL ADVANCED TECHNOLOGY	74,105	221,085	17,541
33	0603003A	03	AVIATION ADVANCED TECHNOLOGY	30,626	28,545	44,843
34	0603004A	03	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	54,324	55,227	29,684
35	0603005A	03	COMBAT VEHICLE AND AUTOMOTIVE ADVANCED TECHNOLOGY	196,362	166,571	193,858
36	0603006A	03	COMMAND, CONTROL, COMMUNICATIONS ADVANCED TECHNOLOGY	27,340	28,243	31,865
37	0603007A	03	MANPOWER, PERSONNEL AND TRAINING ADVANCED TECHNOLOGY	4,869	7,008	3,120
38	0603009A	03	TRACTOR HIKE	12,125	12,105	10,415
39	0603017A	03	TRACTOR RED	2,834	975	0
40	0603020A	03	TRACTOR ROSE	10,743	10,792	9,293
41	0603105A	03	MILITARY HIV RESEARCH	5,750	5,834	5,937
42	0603122A	03	TRACTOR HIP	2,340	971	0
43	0603238A	03	GLOBAL SURVEILLANCE/AIR DEFENSE/PRECISION STRIKE T	24,819	21,112	32,267
44	0603270A	03	EW TECHNOLOGY	15,620	30,575	13,868
45	0603313A	03	MISSILE AND ROCKET ADVANCED TECHNOLOGY	43,828	51,629	59,518
46	0603322A	03	TRACTOR CAGE	2,580	3,055	3,312
47	0603606A	03	LANDMINE WARFARE AND BARRIER ADVANCED TECHNOLOGY	45,748	20,702	23,062
48	0603607A	03	JOINT SERVICE SMALL ARMS PROGRAM	8,507	4,428	5,828
49	0603654A	03	LINE-OF-SIGHT TECHNOLOGY DEMONSTRATION	37,188	50,262	57,384
50	0603710A	03	NIGHT VISION ADVANCED TECHNOLOGY	38,470	42,746	37,081
51	0603728A	03	ENVIRONMENTAL QUALITY TECHNOLOGY DEMONSTRATIONS	1,286	11,013	4,826
52	0603734A	03	MILITARY ENGINEERING ADVANCED TECHNOLOGY	15,282	5,160	4,747

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Department of the Army  
FY 2002 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

02-Jul-2001

Line No	Program Element Number	Act	Item	Thousands of Dollars		
				FY 2000	FY 2001	FY 2002
53	0603772A	03	ADVANCED TACTICAL COMPUTER SCIENCE AND SENSOR TECH	27,043	15,470	18,513
Total: Advanced technology development				718,636	815,276	667,294
Demonstration/validation						
54	0603308A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION (DEM/VAL)	68,653	96,380	19,491
55	0603619A	04	LANDMINE WARFARE AND BARRIER - ADV DEV	11,802	22,594	21,651
56	0603639A	04	TANK AND MEDIUM CALIBER AMMUNITION	48,062	49,635	32,986
57	0603653A	04	ADVANCED TANK ARMAMENT SYSTEM (ATAS)	16,589	265,681	101,461
58	0603713A	04	ARMY DATA DISTRIBUTION SYSTEM	3,748	17	0
59	0603747A	04	SOLDIER SUPPORT AND SURVIVABILITY	11,087	13,449	17,482
60	0603766A	04	TACTICAL SUPPORT DEVELOPMENT - ADV DEV (TIARA)	0	0	16,749
61	0603774A	04	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT	6,455	14,831	12,756
62	0603779A	04	ENVIRONMENTAL QUALITY TECHNOLOGY DEM/VAL	4,795	13,275	7,536
63	0603782A	04	WARFIGHTER INFORMATION NETWORK-TACTICAL - DEM/VAL	0	0	15,075
64	0603790A	04	NATO RESEARCH AND DEVELOPMENT	1,820	1,902	8,633
65	0603801A	04	AVIATION - ADV DEV	8,509	9,757	9,105
66	0603802A	04	WEAPONS AND MUNITIONS - ADV DEV	14,958	35,847	31,670
67	0603804A	04	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	7,876	6,260	7,456
68	0603805A	04	COMBAT SERVICE SUPPORT CONTROL SYSTEM EVALUATION A	11,281	13,627	8,696
69	0603807A	04	MEDICAL SYSTEMS - ADV DEV	16,276	15,367	15,506
70	0603850A	04	INTEGRATED BROADCAST SERVICE (JMIP/DISTP)	0	0	1,985
71	0603851A	04	TRACTOR CAGE (DEM/VAL)	1,057	970	3,718
72	0603854A	04	ARTILLERY SYSTEMS - DEM/VAL	263,844	352,051	447,949
73	0603856A	04	SCAMP BLOCK II	10,403	20,135	9,895
74	0603869A	04	MEADS CONCEPTS - DEM/VAL	0	0	73,645
Total: Demonstration/validation				507,215	931,778	863,445
Engineering and manufacturing development						
75	0604201A	05	AIRCRAFT AVIONICS	10,272	41,893	57,474

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 Department of the Army  
 FY 2002 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

02-Jul-2001

Line No	Program Element Number	Act	Item	Thousands of Dollars		
				FY 2000	FY 2001	FY 2002
76	0604220A	05	ARMED, DEPLOYABLE OH-58D	0	528	2,345
77	0604223A	05	COMANCHE	458,459	608,410	787,866
78	0604270A	05	EW DEVELOPMENT	79,196	69,413	57,010
79	0604280A	05	JOINT TACTICAL RADIO SYSTEM	36,310	61,648	80,449
80	0604321A	05	ALL SOURCE ANALYSIS SYSTEM	55,530	43,680	42,166
81	0604328A	05	TRACTOR CAGE	2,809	2,890	3,888
82	0604329A	05	COMMON MISSILE	0	4,923	16,731
83	0604601A	05	INFANTRY SUPPORT WEAPONS	0	2	0
84	0604604A	05	MEDIUM TACTICAL VEHICLES	1,947	1,942	1,962
85	0604609A	05	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ENG DEV	915	3,428	7,920
86	0604611A	05	JAVELIN	1,961	485	492
87	0604619A	05	LANDMINE WARFARE	13,142	15,756	18,938
88	0604622A	05	FAMILY OF HEAVY TACTICAL VEHICLES	1,365	0	0
89	0604633A	05	AIR TRAFFIC CONTROL	4,890	2,008	2,197
90	0604641A	05	TACTICAL UNMANNED GROUND VEHICLE (TUGV)	4,877	297	0
91	0604642A	05	LIGHT TACTICAL WHEELED VEHICLES	6,783	9,802	2,523
92	0604645A	05	ARMORED SYSTEMS MODERNIZATION (ASM)-ENG. DEV.	2,861	2,180	0
93	0604649A	05	ENGINEER MOBILITY EQUIPMENT DEVELOPMENT	46,650	14,862	9,279
94	0604710A	05	NIGHT VISION SYSTEMS - ENG DEV	31,989	33,764	24,201
95	0604713A	05	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	64,457	88,502	91,002
96	0604715A	05	NON-SYSTEM TRAINING DEVICES - ENG DEV	80,152	75,522	26,319
97	0604716A	05	TERRAIN INFORMATION - ENG DEV	5,423	6,027	8,840
98	0604726A	05	INTEGRATED METEOROLOGICAL SUPPORT SYSTEM	2,351	1,754	1,911
99	0604738A	05	JSIMS CORE PROGRAM	0	0	30,985
100	0604739A	05	INTEGRATED BROADCAST SERVICE	4,618	6,005	0
101	0604741A	05	AIR DEFENSE COMMAND, CONTROL AND INTELLIGENCE - EN	12,008	16,310	18,233
102	0604742A	05	CONSTRUCTIVE SIMULATION SYSTEMS DEVELOPMENT	0	0	66,164
103	0604746A	05	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	15,924	12,837	11,582
104	0604760A	05	DISTRIBUTIVE INTERACTIVE SIMULATIONS (DIS) - ENGIN	8,173	20,501	26,058
105	0604766A	05	TACTICAL EXPLOITATION SYSTEM/DCGS (TIARA)	73,442	57,884	68,205

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 Department of the Army  
 FY 2002 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

02-Jul-2001

Line No	Program Element Number	Act	Item	Thousands of Dollars		
				FY 2000	FY 2001	FY 2002
106	0604768A	05	BRILLIANT ANTI-ARMOR SUBMUNITION (BAT)	139,130	97,203	123,899
107	0604770A	05	JOINT SURVEILLANCE/TARGET ATTACK RADAR SYSTEM	26,030	28,632	8,093
108	0604778A	05	POSITIONING SYSTEMS DEVELOPMENT (SPACE)	1,663	2,398	0
109	0604780A	05	COMBINED ARMS TACTICAL TRAINER (CATT)	38,563	18,328	13,645
110	0604783A	05	JOINT NETWORK MANAGEMENT SYSTEM	0	0	26,130
111	0604801A	05	AVIATION - ENG DEV	14,111	11,993	2,263
112	0604802A	05	WEAPONS AND MUNITIONS - ENG DEV	57,458	32,703	7,046
113	0604804A	05	LOGISTICS AND ENGINEER EQUIPMENT - ENG DEV	22,506	24,333	30,673
114	0604805A	05	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ENG DEV	28,503	61,249	122,644
115	0604807A	05	MEDICAL MATERIEL/MEDICAL BIOLOGICAL DEFENSE EQUIPM	9,598	6,261	8,228
116	0604808A	05	LANDMINE WARFARE/BARRIER - ENG DEV	24,458	93,717	89,153
117	0604814A	05	SENSE AND DESTROY ARMAMENT MISSILE - ENG DEV	24,001	31,513	67,258
118	0604817A	05	COMBAT IDENTIFICATION	17,705	5,313	3,014
119	0604818A	05	ARMY TACTICAL COMMAND & CONTROL HARDWARE & SOFTWARE	43,387	39,059	50,887
120	0604819A	05	LOSAT	0	26,555	21,596
121	0604820A	05	RADAR DEVELOPMENT	5,060	13,306	5,162
122	0604823A	05	FIREFINDER	39,641	46,928	26,956
123	0604854A	05	ARTILLERY SYSTEMS - EMD	4,763	19,920	62,481
124	0604865A	05	PATRIOT PAC-3 THEATER MISSILE DEFENSE ACQ - EMD	0	0	107,100
125	0605013A	05	INFORMATION TECHNOLOGY DEVELOPMENT	0	94,886	98,178
Total: Engineering and manufacturing development				1,523,081	1,857,550	2,339,146
Management support						
126	0604256A	06	THREAT SIMULATOR DEVELOPMENT	19,170	20,808	16,011
127	0604258A	06	TARGET SYSTEMS DEVELOPMENT	12,904	15,252	25,212
128	0604759A	06	MAJOR T&E INVESTMENT	37,953	43,616	49,897
129	0605103A	06	RAND ARROYO CENTER	16,990	19,689	19,972
130	0605301A	06	ARMY KWAJALEIN ATOLL	135,217	151,920	150,071
131	0605326A	06	CONCEPTS EXPERIMENTATION	21,285	18,738	33,067
132	0605502A	06	SMALL BUSINESS INNOVATIVE RESEARCH	115,654	0	0

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FY 2002 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

02-Jul-2001

Line No	Program Element Number	Act	Item	Thousands of Dollars		
				FY 2000	FY 2001	FY 2002
133	0605601A	06	ARMY TEST RANGES AND FACILITIES	144,153	121,532	114,411
134	0605602A	06	ARMY TECHNICAL TEST INSTRUMENTATION AND TARGETS	32,825	36,915	34,259
135	0605604A	06	SURVIVABILITY/LETHALITY ANALYSIS	37,021	36,905	27,794
136	0605605A	06	DOD HIGH ENERGY LASER TEST FACILITY	29,717	37,177	14,570
137	0605606A	06	AIRCRAFT CERTIFICATION	2,958	3,171	3,582
138	0605702A	06	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	6,727	6,864	6,890
139	0605706A	06	MATERIEL SYSTEMS ANALYSIS	10,198	8,657	8,884
140	0605709A	06	EXPLOITATION OF FOREIGN ITEMS	4,097	3,549	3,525
141	0605712A	06	SUPPORT OF OPERATIONAL TESTING	68,689	68,149	89,047
142	0605716A	06	ARMY EVALUATION CENTER	26,413	26,095	31,365
143	0605801A	06	PROGRAMWIDE ACTIVITIES	64,176	60,734	69,096
144	0605803A	06	TECHNICAL INFORMATION ACTIVITIES	18,755	30,219	33,749
145	0605805A	06	MUNITIONS STANDARDIZATION, EFFECTIVENESS AND SAFET	18,246	16,622	16,072
146	0605856A	06	ENVIRONMENTAL COMPLIANCE	3,986	2,477	0
147	0605857A	06	ARMY ACQUISITION POLLUTION PREVENTION PROGRAM	0	5,368	1,733
148	0605898A	06	MANAGEMENT HEADQUARTERS (RESEARCH AND DEVELOPMENT)	27,026	8,293	7,268
149	0909999A	06	FINANCING FOR CANCELLED ACCOUNT ADJUSTMENTS	310	0	0
Total: Management support				854,470	742,750	756,475
Operational system development						
150	0102419A	07	JOINT LAND ATTACK CRUISE MISSILES DEFENSE (JLENS)	23,242	26,743	30,408
151	0203610A	07	DOMESTIC PREPAREDNESS AGAINST WEAPONS OF MASS DEST	5,791	2,972	0
152	0203726A	07	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	34,147	36,471	36,969
153	0203735A	07	COMBAT VEHICLE IMPROVEMENT PROGRAMS	84,004	100,575	195,602
154	0203740A	07	MANEUVER CONTROL SYSTEM	40,695	48,454	40,231
155	0203744A	07	AIRCRAFT MODIFICATIONS/PRODUCT IMPROVEMENT PROGRAM	71,761	106,831	143,631
156	0203752A	07	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	3,626	5,873	13,017
157	0203758A	07	DIGITIZATION	31,414	30,384	29,302
158	0203759A	07	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW (FBCB2	63,945	64,009	56,872
159	0203761A	07	FORCE XXI WRAP	0	0	23,593

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 FY 2002 RDT&E Program

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

02-Jul-2001

Line No	Program Element Number	Act	Item	Thousands of Dollars		
				FY 2000	FY 2001	FY 2002
160	0203801A	07	MISSILE/AIR DEFENSE PRODUCT IMPROVEMENT PROGRAM	10,804	12,248	8,539
161	0203802A	07	OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS	12,755	55,900	84,935
162	0203808A	07	TRACTOR CARD	3,634	3,801	6,551
163	0208010A	07	JOINT TACTICAL COMMUNICATIONS PROGRAM (TRI-TAC)	16,345	38,563	21,615
164	0208053A	07	JOINT TACTICAL GROUND SYSTEM	26,856	6,208	5,221
165	0301359A	07	SPECIAL ARMY PROGRAM	22,943	5,178	5,072
166	0303028A	07	SECURITY AND INTELLIGENCE ACTIVITIES	6,451	0	452
167	0303140A	07	INFORMATION SYSTEMS SECURITY PROGRAM	14,344	14,503	8,261
168	0303141A	07	GLOBAL COMBAT SUPPORT SYSTEM	0	73,664	94,177
169	0303142A	07	SATCOM GROUND ENVIRONMENT (SPACE)	33,778	42,926	47,647
170	0303150A	07	WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM	10,525	14,101	13,501
171	0305114A	07	TRAFFIC CONTROL, APPROACH AND LANDING SYSTEM-FY 19	0	775	785
172	0305204A	07	TACTICAL UNMANNED AERIAL VEHICLES	45,087	34,110	38,210
173	0305206A	07	AIRBORNE RECONNAISSANCE ADV DEVELOPMENT	4,725	4,852	6,862
174	0305208A	07	DISTRIBUTED COMMON GROUND SYSTEMS (JMIP)	7,726	7,821	85,242
175	0603778A	07	MLRS PRODUCT IMPROVEMENT PROGRAM	62,252	68,886	111,389
176	0708045A	07	END ITEM INDUSTRIAL PREPAREDNESS ACTIVITIES	82,483	89,067	45,697
177	1001018A	07	NATO JOINT STARS	194	0	2,109
Total: Operational system development				719,527	894,915	1,155,890
Total: RDT&E, Army				5,313,987	6,279,892	6,693,920



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6	0602120A	Sensors & Electronic Survivability	115
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1	DOD Compt, Management Improvement, Pentagon, Room 1A658, Washington, DC 20301-1100
1	DOD(C)(CFO), Pentagon, Room 1B728, Washington, DC 20301-1100
1	USD (Policy), Pentagon, Room 4B926, Washington, DC 20301-2100
1	USD(A&T), Mailroom, Pentagon, Room 3D139, Washington, DC 20310
1	OSD, ATTN: DOT&E, Pentagon, Room 3E318, Washington, DC 20301
1	ASD(C3I), Pentagon, Room 3E209, Washington, DC 20301
1	ASD(ISA), Pentagon, Room 4B938, Washington, DC 20301
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12	HQDA (SAFM-BUI-A), Suite 11500, 2511 South Jefferson Davis Highway, Arlington, VA 22202-3925
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- \* 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
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- \* Commander, US Army Medical R&D Command, ATTN: SGRD-PR, Fort Detrick, Frederick, MD 21701-5012
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- \* CDR, Army Intelligence Ctr and FT. Huachuca, ATTN: ATZS-CDI-I, ATZS-CDT, Ft. Huachuca, AZ 85613-7000
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- \* CDR, USACHCS, ATTN: ATSC-CD, Ft. Monmouth, NJ 07703-5612
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- \* Commander, US Army Materiel Command, ATTN: AMCAE-P, 5001 Eisenhower Avenue, Alexandria, VA 22333
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- \* Commander, US Army Chemical, Biological and Defense Command, ATTN: SCBRD-ASA, Aberdeen Proving Ground, MD 21010-5423
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- \* 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: SFAE-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
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- \* HQ US Marine Corps, Deputy Chief of Staff for RD&S, Code (MC-RDP-30), Washington, DC 20380
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# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

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

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	13855	14326	14815	0	0	0	0	0	0	0
91A ILIR-AMC	9596	9930	10294	0	0	0	0	0	0	0
91C ILIR-MED R&D CMD	3541	3669	3775	0	0	0	0	0	0	0
91D ILIR-CORPS OF ENGR	718	727	746	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

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 promising young scientists and engineers. Successful ILIR projects are typically transitioned to start-up projects under 6.1 or 6.2 mission funding within an organization. Many past and current ILIR projects have supported or are currently supporting developmental efforts in support of the Objective Force. ILIR funding allocations are based on past program performance as judged by a panel of leading scientists and engineers from the National Academy of Sciences, the Army Science Board, and Army Secretariat. 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 in the Army's research organizations. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DOD Basic Research Plan. The program element contains no duplication with any effort within the Military Departments.

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<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	14119	14459	14763	0
Appropriated Value	14193	14459	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-264	0	0	
c. Omnibus or Other Above Threshold Reductions	-40	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-34	-133	0	
Adjustments to Budget Years Since FY2001 PB	0	0	52	
Current Budget Submit (FY 2002/2003 PB )	13855	14326	14815	0

Projects with no R-2A

Project 91D:

- (FY02 Funding = \$746) ILIR-Corps of Engr (91D): This project covers ILIR research conducted at the Engineer Research and Development Center (ERDC) addressing military operational environments, mine detection and neutralization, subsurface contaminant and unexploded ordnance detection and mitigation, and civil works efforts. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

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BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

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

PROJECT  
**91A**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
91A ILIR-AMC	9596	9930	10294	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides funding for ILIR research in the Army Materiel Command's seven Research, Development and Engineering Centers (RDECs). This basic research lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. Past and current ILIR efforts have had and are having significant impacts on technology development efforts supporting the Army Transformation and the Objective Force. This project supports the Objective Force transition path of the Transformation Campaign Plan.

**FY 2000 Accomplishments**

- 9596 - Missile RDEC - Developed Coefficient Polynomial Arithmetic (CPA) and Parallel Arithmetic Structures methodology to greatly reduce processing time for Automatic Target Recognition; developed and improved analytical models and Computational Fluid Dynamics (CFD) models to evaluate neutralization of chemical/biological missile warheads, jet-interaction to control plume degradation of interceptor seeker performance, and high speed separated flows; derived and analyzed the fundamental loss rate (spontaneous emission rate) of solid-state lasers to increase laser efficiency; completed data collection and modeling methodology for ablation phenomena affecting heatshield materials for hypersonic missiles; determined the controlling mechanism for the decomposition of gel propellants to extend their shelf life.
- Armaments RDEC - Conducted research to develop metastable intermolecular composites (nanoparticle explosives) as a new class of more powerful explosives; examined low cost fuzing technology (MEMS, multi-function processing) to develop more effective fuzes; advanced barrel coating modeling and effects studies of high flame temperatures and high pressures to increase gun barrel life; evaluated smart materials to enable projectile in-flight course correction.
- Tank-Automotive RDEC - Improved concepts for a unique advanced propulsion technology, sophisticated multibody ground vehicle dynamic systems, and advanced signature management techniques to support development of sensor systems and vehicles that are lighter, more mobile, and highly survivable for Objective Force applications.
- Natick Soldier Center - Validated mathematical models to gain insights into protective properties, strength of fabrics, and aerodynamics of parachutes. Examined creation of new high performance polymers for fabrics and protection applications. Characterized and enhanced food biopreservative function.

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Research**

PROJECT

**91A**

## FY 2000 Accomplishments (Continued)

- Edgewood Chemical Biological Center - Validated concept for a specific virus detector. Started development of data reduction/analysis algorithms needed for satellite/high altitude chemical imaging sensors.
- Aviation RDEC - Optimized blowing-slot location, frequency of oscillation, and amplitude of blowing in the dynamic stall environment for rotor blades; constructed a full-scale Particle Image Velocimeter for imaging airflow over concept rotor blades; developed design approaches and concepts to integrate the actuation system with the blade structure to enable continuous elastic deformation of the airfoil contour near the trailing edge of a rotor blade.
- Communications-Electronics RDEC - Transitioned antenna technologies, improved power sources technology, and advanced the sensor technology base.

Total 9596

## FY 2001 Planned Program

- 9710 - Missile RDEC - Validate gel propellant additive technology to extend missile propellant shelf life to 20 years; investigate the use of extended capillary electrophoresis to analyze missile propellant formulations and their synthetic by-products to reduce the amount of waste produced during explosives production by 90%; determine the ignition criteria and chemical/particulate formulation for neutralization of chemical/biological missile warheads and determine concept feasibility; analyze and model the driving potential physics for the fluctuating control force on interceptor sensor performance and compare results with experimental data, making possible electro-optical guidance techniques for hypervelocity missiles; investigate and develop ablation models for hypervelocity missiles components (nose cone, IR dome, nozzles); investigate the control of high frequency chaos in diode lasers tested leading to high efficiency/lower cost diode lasers; fabricate photonic band gap materials to provide sensor protection of missile guidance systems against optical countermeasures.
- Armaments RDEC - Characterize metastable intermolecular composites for more powerful explosives development. Examine the areas of high pressure loading of composite materials for increasing gun components life. Develop smart materials to provide in flight course corrections of ballistic projectiles.
- Tank-Automotive RDEC - Evaluate/validate the accuracy and sensitivity of warfighting requirements simulation models for advanced propulsion, non-linear multibody dynamics, signature management and nontraditional material stress analysis to support development of vehicles for the Objective Force that are lighter, more mobile, and highly survivable.
- Natick Soldier Center - Transition results from biotechnology efforts to improve ration safety and to provide more serviceable chemical protective fabrics.

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

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BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601101A - In House Laboratory Independent  
Research**

PROJECT

**91A**

## FY 2001 Planned Program (Continued)

- Edgewood Chemical Biological Center - Develop a specific virus detector based on previously validated concepts. Construct 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 microelectromechanical systems (MEMS) to alleviate dynamic stall and improve rotor blade aerodynamics.
- Communications-Electronics RDEC - Upgrade battlefield visualization tools, transition newly developed antenna technologies, improve power sources technology, and advance sensor technology base to provide greater communications and sensors capabilities for the warfighter.

• 220 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9930

## FY 2002 Planned Program

- 10294 - Missile RDEC - Transition long shelf lifetime gel propellant technology to the Compact Kinetic Energy Missile (CKEM) development effort for Objective Force applications; validate and transition methods to reduce the propellant synthesis waste by 90%; transition analytical and Computational Fluid Dynamics models and new designs into current and future missile systems for both chemical/biological warhead neutralization and guidance sensor improvement; validate improved heatshield designs for hypervelocity missiles nose cones, IR domes, and reduction of nozzle throat erosion to advance capabilities of Army missiles; validate chaos control techniques for diode lasers to enable advanced laser systems development; transition photonic bandgap sensor protection technology to current and evolving missile programs.
- Armaments RDEC - Develop new metastable intermolecular composites for explosives applications; develop new composite materials that will extend the operational life of gun components; develop new smart materials to enable in-flight course corrections of ballistic projectiles.
- Tank-Automotive RDEC - Refine warfighting requirements simulation models for advanced propulsion, non-linear multibody dynamics, signature management and nontraditional material stress analysis to support development of vehicles for the Objective Force that are lighter, more mobile, and highly survivable.
- Natick Soldier Center - Create models for transition to technology efforts that address improved human performance and new materials for individual protection. Specifically, these models will assess: cognitive function as affected by performance enhancing nutrients; and air gaps in clothing systems as they affect heat transfer.
- Edgewood Chemical Biological Center - Develop and model specific virus detectors based on previously validated concepts. Evaluate effectiveness of data reduction/analysis algorithms needed for the development of a satellite/high altitude chemical imaging sensor.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601101A - In House Laboratory Independent  
Research**

PROJECT

**91A**

**FY 2002 Planned Program (Continued)**

- Aviation RDEC - Conduct buildup of Background Oriented Stereoscopic Schlieren technique for full-scale vortex applications to increase rotor blade performance.
- Communications-Electronics RDEC - Evaluate concepts for new electronics materials for more powerful, reliable and lighter weight battlefield visualization tools, communications systems, power sources technology, and sensors.

Total 10294



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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>				<b>PE NUMBER AND TITLE</b> <b>0601101A - In House Laboratory Independent Research</b>					<b>PROJECT</b> <b>91C</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
91C ILIR-MED R&D CMD	3541	3669	3775	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project covers ILIR research to address medical and force protection needs at the six Medical Research and Materiel Command laboratories; the Aeromedical Research Laboratory, the Institute of Surgical Research, the Research Institute of Environmental Medicine, the Medical Research Institute of Chemical Defense, the Medical Research Institute of Infectious Diseases, and Walter Reed Army Institute of Research. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2260 Evaluated transdermal delivery of malaria vaccine and explored the immune cell responses generated by this delivery mechanism. Preliminary data indicate this new painless immunization technique may enhance immune response and offer better protection for soldiers.  
Elucidated the structure of the protein complex that enables the malaria parasite to invade red blood cells. Synthesized chemically, and by gene expression, the protein that will be used in an in vitro malaria assay.
- 1092 Explored use of the new cDNA microarray technology to evaluate the molecular actions that result in disease, after infection by Filovirus. These studies will enable a better understanding of the mechanism of action, resulting in novel drugs and vaccines.  
Investigated the use of novel approaches to predict the stability and potency of new vaccines. This modeling approach will enable more rapid screening of vaccine stockpiles and may thus significantly reduce screening time and cost.
- 189 Conducted a study of leg muscle fatigue in humans to enable the development of a laboratory device to more accurately measure the increasing muscle fatigue that occurs in sustained work situations. This capability may yield a better understanding of the phenomenon and lead to appropriate medical countermeasures to enhance warfighter endurance.  
Investigated the new Stress-Gen ELISA Kit for evaluating Heat Shock Protein (HSP72) in humans under stress. A Standard Operating Procedure for determining HSP72 from human blood was drafted based on these findings. The new technique for determining HSP72 is far more suitable for large-scale studies of soldiers under a variety of stressors, and is faster and less costly than other methods.  
Completed a computer simulation model that predicts physiological responses of various body regions to different cyclic microclimate cooling. Findings may lead to strategies that enable soldiers wearing protective clothing to work harder and longer without increased risk of overheating injuries.

Total 3541

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601101A - In House Laboratory Independent  
Research**

PROJECT

**91C****FY 2001 Planned Program**

- 3562 Conduct basic research on countermeasures against militarily relevant infectious diseases to include development of drugs and vaccines against malaria, diarrheal diseases, and viral hemorrhagic fever; defenses against environmental extremes and operational hazards to health and performance as well as development of models to predict physiological responses to these hazards; mechanisms of combat trauma; and development of innovative treatment and surgical procedures.
- 107 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3669

**FY 2002 Planned Program**

- 3775 Explore opportunities for identification of new countermeasures against militarily relevant infectious diseases. Study new vaccine delivery mechanisms including needle-less delivery. Pursue modeling to predict physiological, operational stressors on the battlefield.

Total 3775

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

**June 2001**

**BUDGET ACTIVITY  
1 - BASIC RESEARCH**

**PE NUMBER AND TITLE  
0601102A - Defense Research Sciences**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	123491	136650	138281	0	0	0	0	0	0	0
305 ATR RESEARCH	1121	1194	1237	0	0	0	0	0	0	0
31B INFRARED OPTICS RSCH	2219	2404	2503	0	0	0	0	0	0	0
52C MAPPING & REMOTE SENS	2169	2305	2369	0	0	0	0	0	0	0
53A BATTLEFIELD ENV & SIG	3565	3777	3945	0	0	0	0	0	0	0
74A HUMAN ENGINEERING	2478	2662	2765	0	0	0	0	0	0	0
74F PERS PERF & TRAINING	2554	2778	2855	0	0	0	0	0	0	0
F20 ADV PROPULSION RSCH	2423	2487	2611	0	0	0	0	0	0	0
F22 RSCH IN VEH MOBILITY	452	480	494	0	0	0	0	0	0	0
H42 MATERIALS & MECHANICS	1855	1972	2044	0	0	0	0	0	0	0
H43 RESEARCH IN BALLISTICS	3849	4088	4235	0	0	0	0	0	0	0
H44 ADV SENSORS RESEARCH	3866	4106	4243	0	0	0	0	0	0	0
H45 AIR MOBILITY	1880	2016	9096	0	0	0	0	0	0	0
H47 APPLIED PHYSICS RSCH	2971	3153	3274	0	0	0	0	0	0	0
H48 BATTLESPACE INFO & COMM RSC	6447	6863	7118	0	0	0	0	0	0	0
H52 EQUIP FOR THE SOLDIER	918	975	1014	0	0	0	0	0	0	0
H57 SCI PROB W/ MIL APPLIC	51095	51086	52697	0	0	0	0	0	0	0
H66 ADV STRUCTURES RSCH	1366	1449	1508	0	0	0	0	0	0	0
H67 ENVIRONMENTAL RESEARCH	3342	3537	3644	0	0	0	0	0	0	0
H68 PROC POLLUT ABMT TECH	349	372	382	0	0	0	0	0	0	0
S04 MIL POLLUTANT/HLTH HAZ	589	625	643	0	0	0	0	0	0	0
S13 SCI BS/MED RSH INF DIS	8576	9100	9410	0	0	0	0	0	0	0
S14 SCI BS/CBT CAS CARE RS	3770	4005	4135	0	0	0	0	0	0	0
S15 SCI BS/ARMY OP MED RSH	5129	5445	5631	0	0	0	0	0	0	0
S17 MOLECULAR BIOLOGY-HIV	408	435	447	0	0	0	0	0	0	0
S19 T-MED/SOLDIER STATUS	579	614	635	0	0	0	0	0	0	0
S20 SCIENCE BASE EMERGING INFECTIOUS DISEASES	0	3938	0	0	0	0	0	0	0	0

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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>				<b>PE NUMBER AND TITLE</b> <b>0601102A - Defense Research Sciences</b>							
T22	SOIL & ROCK MECH	1759	1870	1923	0	0	0	0	0	0	0
T23	BASIC RES MIL CONST	1487	1581	1626	0	0	0	0	0	0	0
T24	SNOW/ICE & FROZEN SOIL	2080	2413	1207	0	0	0	0	0	0	0
T25	ENVIRONMENTAL RES-COE	4195	4461	4590	0	0	0	0	0	0	0
T51	COUNTER - TERRORISM RESEARCH	0	2972	0	0	0	0	0	0	0	0
T55	DISPLAY PERFORMANCE & ENVIRONMENTAL EVALUATION	0	1487	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This program element sustains U.S. Army scientific and technological superiority in land warfighting capability, provides new concepts and technologies for the Army's Objective Force, and provides the means to exploit scientific breakthroughs and avoid technology surprise. This program responds to the scientific and technological requirements of the Department of Defense Basic Research Plan, the Army Science and Technology Master Plan, and the Army Modernization Plan by enabling the technologies that can significantly improve joint warfighting capabilities. The in-house portion of the program capitalizes on the Army's scientific talent and specialized facilities to expeditiously transition knowledge and technology into the appropriate developmental activities. The extramural program leverages the research efforts of other government agencies, academia, and industry. This translates to a coherent, well-integrated program which is executed by the five primary contributors: 1) the Army Research Laboratory (ARL), which includes the Army Research Office; 2) the Army Materiel Command Research, Development and Engineering Centers (RDECs); 3) the Army Corps of Engineers Research and Development Center (ERDC); 4) the Army Medical Research and Materiel Command laboratories; and 5) the Army Research Institute. The Army's research program promotes quality through activities such as in-depth reviews of the entire basic research program at all levels and the establishment of Strategic Research Objectives. The Army broadened its research base by expanding its basic research investments at Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs) to 5% of its individual investigator 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 projects in this Program Element involve basic research efforts directed toward providing fundamental knowledge for the solution of military problems related to long-term national security needs and is appropriately in Budget Activity 1. The program element contains no duplication with any effort within the Military Departments.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	125918	132164	130876	0
Appropriated Value	126613	137914	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-2427	0	0	
c. Omnibus or Other Above Threshold Reductions	-370	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-325	-1264	0	
Adjustments to Budget Years Since FY2001 PB	0	0	7405	
Current Budget Submit (FY 2002/2003 PB )	123491	136650	138281	0

Change Summary Explanation: In FY 2001, Congressional adds were made for Counter-Terrorism Research (\$3000); Cold Regions Military Engineering, Project T24 (\$1250); and the Display Performance and Environmental Evaluation Project (\$1500).  
 - (\$3000) Counter-Terrorism Research: The objective of this one year add is to develop technologies to deter, resolve, and mitigate terrorist acts, including physical structure and weapon's effects research. No additional funding is required to complete this project.  
 - (\$1500) Display Performance and Environmental Evaluation Project: The objective of this one year Congressional add is to develop techniques and instrumentation to evaluate the performance of computer and electronic equipment displays (particularly flat panel displays) in order to guide the selection, development, and implementation of appropriate displays for the Army. No additional funding is required to complete this project.

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BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

Projects with no R-2A:

F22:

- (FY02 Funding = \$494) Research in Vehicle Mobility (F22): Conduct research in support of advanced military vehicle technology with emphasis on advanced propulsion, sophisticated vehicle dynamics and simulation, and advanced track and suspension concepts.

H68:

- (\$382) Processes in Pollution Abatement Technology (H68): Provide fundamental understanding of the physical, chemical and biological properties of hazardous wastes and mechanisms that control their degradation and treatment on military installations.

S04:

- (\$643) Military Pollutants and Health Hazards (S04): Develop innovative, less costly, and less time consuming toxicity assessment methods for determining potential human health and environmental effects of military-unique hazardous wastes and chemicals, including explosives, propellants, and smokes.

S17:

- (\$447) Molecular Biology/Military HIV Research (S17): Develop methods for the prevention, early diagnosis, and treatment of human immunodeficiency virus (HIV).

S19:

- (\$635) Telemedicine Soldier Status Research (S19): Improve combat casualty care for troops through faster diagnosis and treatment by enabling on-site health care providers to consult with specialists worldwide. This effort focuses on advancing the means to determine soldier physiological status and aiding medical diagnosis and treatment.

S20:

- (\$3938) Science Base Emerging Infectious Diseases (S20): This one year congressional add focuses on speeding development of infectious disease threat countermeasures to support operations in non-industrialized countries and those in which infrastructure has been damaged or destroyed. No additional funding is required to complete this project.

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<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>				<b>PE NUMBER AND TITLE</b> <b>0601102A - Defense Research Sciences</b>					<b>PROJECT</b> <b>305</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
305    ATR RESEARCH	1121	1194	1237	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports basic research on the fundamental underpinnings of aided and unaided target detection and identification techniques for land warfare. Future Army systems must be able to act independently of the human operator to detect and track targets. Such capabilities are needed for smart munitions, unattended ground sensors and replacements for existing systems such as land mines. Critical technology issues include low depression angle, relatively short range, and highly competing clutter backgrounds. Electro-optic/infrared imaging systems that use advanced algorithms for compressing data, detecting and identifying targets over extended battlefield conditions are essential for the warfighter in the Objective Force. The research resulting from this project will provide fundamental capability to predict, explain, and characterize target and background signature content, and reduce the workload on the soldier. This research is aimed at understanding the complexity and variability of target and clutter signatures and ultimately will utilize that knowledge to conceptualize and design advanced Automatic Target Recognition (ATR) paradigms to enhance robustness and effectiveness of land warfare systems. ATR research strategies include emerging sensor modalities such as spectral imaging and multisensor imaging. These research findings support several technology efforts including multidomain smart sensors, third generation forward looking infrared (FLIR), advanced multi-function LADAR technology. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1121        - Assessed quality of ground thermal predictions for various ground vehicle scenarios.
- Devised algorithms for computing image complexity and applied to relevant data sets.
- Analyzed the fidelity of synthetic target image chips for use in ATR development.

Total    1121

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BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**305**

## FY 2001 Planned Program

- 1174 - Assess fidelity of thermal predictions for signature data and improve the models as indicated.
    - Correlate performance of one or more ARL ATR algorithms with image complexity measures.
    - Conduct phenomenological studies of hyperspectral data to assess minimum number of bands needed to achieve high discrimination performance with low cost trade off.
  - 20 - Funds reprogrammed for SBIR/STTR programs.
- Total 1194

## FY 2002 Planned Program

- 1237 - Provide framework for use of synthetic target image chips in the training and testing new ATR algorithms.
    - Design new ATR approaches using hyperspectral data cubes and compare hyperspectral ATR algorithms to broadband and dualband ATR algorithm performance.
- Total 1237



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June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**31B**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
31B      INFRARED OPTICS RSCH	2219	2404	2503	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports the Army's theoretical and experimental research in materials and devices for active and passive IR imaging systems. It generates new technologies to obtain unprecedented awareness of the battlefield and to continue to "own the night" notwithstanding foreign competition. To achieve these objectives for the Objective Force, IR Focal Plane Arrays (IRFPAs) with significantly improved performance, lower cost, and increased operating temperatures and compact low cost laser radar (ladar) architectures are needed. Research is therefore focused on material growth, detector design and processing for large area multicolor IRFPAs. The main efforts are directed towards mercury cadmium telluride (HgCdTe) detector arrays grown on silicon (Si) substrates, antimonide (Sb) base superlattices, and quantum well and quantum dot infrared photon detectors. For the compact frequency modulated/continuous wave (FM/CW) ladar, research has to be performed for some critical components, especially for a high frequency detector/modulator array. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2219      - Prototypes of high power 1.5-micron diode laser were built.
- 0.8-micron detector/modulator for ladar with 600 MHz bandwidth was processed and tested.
- Validated vertical cavity surface emitting laser (VCSEL) operation at IR Focal Plane Array (FPA) operating temperatures (77°K).
- First growth of HgCdTe on Si completed.

Total    2219

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**31B**

## FY 2001 Planned Program

- 2388 - Examine fundamental aspects of material growth and device design for long wave infrared (LWIR) FPA operating above 100°K.
  - Grow and process detector/modulator for ladar designed for 1.5-micron detection.
  - Examine fundamental aspects of design of IRFPAs to be utilized for active and passive imaging.
- 16 - Funds reprogrammed for SBIR/STTR programs.

Total 2404

## FY 2002 Planned Program

- 2503 - Evaluate chemical and structural properties of HgCdTe for near room temperature operation.
  - Investigate controlled low-defect growth of Sb-based superlattices and quantum dots.
  - Grow and process 2D detector/modulator array for 1.5-micron ladar.

Total 2503

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**52C**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
52C MAPPING & REMOTE SENS	2169	2305	2369	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to support 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. This research greatly improves situational awareness capabilities and enhances information dominance that will lead to increased survivability, lethality, and mobility capabilities for the Objective Force, the Future Combat Systems and Joint/Army Vision 2020. The research provides the theoretical underpinnings for program element 0602784A, project 855. This work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2169 - Investigated multivariate statistical analysis, multivariate interpolation, and enhancements for image analysis.
- Investigated generating topographic data using a combination of sensor information.
- Evaluated initial geostatistical models of climatic atmospheric parameters integrated with line-of-sight models for denied areas where limited or no data is available.
- Evaluated models and their performance to characterize expected battlefield state against actual data sets from operational databases.

Total 2169

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**52C**

## FY 2001 Planned Program

- 2257 - Investigate enhancement of neural net and subpixel methods of feature extraction to gain processing speed and increase information detail.
  - Investigate hyperspectral imagery analysis/segmentation to improve feature differentiation and identification.
  - Devise model to predict precipitation frequency data in the absence of weather data in denied areas to permit greater operational use of terrain.
  - Investigate the potential to integrate empirical and inductive analysis systems to increase speed and accuracy of analysis and to enhance descriptive quality of results.
- 48 - Funds reprogrammed for SBIR/STTR program.

Total 2305

## FY 2002 Planned Program

- 2369 - Investigate fluorescence feature extraction for enhanced accuracy and detail.
  - Investigate multispectral and hyperspectral image compression for reducing process time and data storage requirements.
  - Refine precipitation frequency model variables for greater accuracy in terrain condition prediction.
  - Investigate threat/terrain software and models for specific geographic areas.

Total 2369

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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>				<b>PE NUMBER AND TITLE</b> <b>0601102A - Defense Research Sciences</b>					<b>PROJECT</b> <b>53A</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
53A BATTLEFIELD ENV & SIG	3565	3777	3945	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides an in-depth understanding of the complex atmospheric boundary layer associated with high-resolution meteorology, the transport, dispersion, optical characteristics and detection of chemical and biological aerosols, and the propagation of full-spectrum electro-magnetic and acoustic energy. The Army of the future will be required to operate in very complex environments and disparate terrains requiring new approaches to understanding, characterizing, and depicting microscale atmospheric phenomena. The lack of a complete understanding of the meteorological aspects of the complex microscale boundary layer in which the Army operates continues to have impacts on abilities to provide accurate and timely tactical weather intelligence to battlefield commanders. This project impacts Army chemical and biological defense operations, electro-optic and acoustic sensors, smoke/obscurant deployments and target acquisition. This project supports Army Strategic Research Objective, Intelligent Systems, 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 research leader in boundary layer meteorology over land and urban terrain. This project supports the Army's transformation to the Objective Force through the development of future capabilities and applications in such areas as the detection and identification of biowarfare agents, enhanced acoustic and electro-optic propagation modeling techniques for improved target detection and acquisition, and the development of objective analysis tools that can assimilate on-scene weather observations and fuse this information with forecasts to provide immediate nowcast products. These capabilities will have a direct impact on ensuring soldier survivability, weapon system lethality, and the mobility required for future combat operations. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3565 - Performed experimentation and modeled acoustic array performance in non line-of-sight and multipath conditions.
  - Completed theory and software linking 3-D atmospheric propagation and radiative transfer models to standard interfaces such as the Total Atmospheric and Oceans Server (TAOS) to improve virtual testing, analysis, and simulation capabilities.
  - Compared coupled 3-D surface layer/boundary layer meteorological model with experimental data for verification and validation of a hazard avoidance tactical decision aid.
  - Investigated methods for real-time discrimination between naturally-occurring and man-made aerosols using both fluorescence and elastic scattering for real-time detection of biological warfare agents.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**53A**

## FY 2000 Accomplishments (Continued)

- Coupled canopy and urban flow technologies into transport and dispersion models for more realistic depiction of smoke, atmospheric clouds, dust aerosols and BW/CW agents on the battlefield.
- Incorporated detailed Surface Energy Balance in Surface Layer Model for improved thermal dynamics.
- Participated in a joint interagency stable boundary layer meteorological field experiment, Cooperative Atmospheric Surface Exchange Study (CASES-99), to achieve a better understanding of stable boundary layer processes for environmental model performance improvements.
- Determined 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.
- Extended capabilities of acoustic target recognition into more complex environments through research on theory and numerical models of propagation of sound through inhomogeneous anisotropic turbulence including refraction and ground reflections.

Total 3565

## FY 2001 Planned Program

- 3726 - Use Cooperative Atmospheric Surface Exchange Study (CASES-99) data to model acoustic propagation in diurnal conditions.
- Investigate the feasibility of extracting environmental data from hyperspectral imagery to make possible an enhanced capability for target detection and acquisition.
- Investigate the use of multiple excitation wavelengths and elastic scattering in characterizing aerosol particles, especially biological warfare agents.
- Model and perform experiments on low frequency acoustic propagation in forest canopies and littoral regions to assess environmental impacts on acoustic sensors.
- Evaluate new algorithms for depicting physical processes to better analyze turbulence, wind shear, and visibility at the temporal and spatial scales required for accurate, quantitative depiction of target area atmospheric conditions.
- Integrate a new Cumulus Parameterization Scheme for estimating convective precipitation into hydrostatic mesoscale models that will significantly improve fine-scale predictions of clouds and precipitation in the battlespace area.
- Compare coupled 3-D surface layer/boundary layer meteorological model with experimental data over complex terrain and urban morphology domains for verification and validation.
- Incorporate detailed surface energy balance in surface layer model for improved thermodynamic and stability effects.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**53A**

## FY 2001 Planned Program (Continued)

- Improve the boundary layer model by incorporating algorithms for stable atmospheric conditions.
  - 51 - Funds reprogrammed for SBIR/STTR programs.
- Total 3777

## FY 2002 Planned Program

- 3945
  - Improve tactical target acquisition using the additional dimension of polarization to more completely characterize the state of reflected and thermal radiation.
  - Model and perform experiments on high-frequency acoustic propagation in forest canopies and littoral regions.
  - Research new high resolution, short-range forecasting models that can be initialized with meteorological data from critical areas of the battlefield. Improved models will directly impact nowcast accuracies for Objective Force operating areas and target areas.
  - Participate in a multi-agency field experiment investigating dispersion in urban domains to gain an understanding of the impact of urban terrain on dispersion.
  - Investigate and correct problems with the transilient turbulence model to decrease computational requirements for counter-gradient dispersion.
  
  - Investigate the scientific foundation for a hazard avoidance decision aid using the coupled 3-D surface layer/boundary layer transport and dispersion model.
  - Investigate methods for performing 3-D data assimilation techniques with combined boundary layer and transport and dispersion models.
  
  - Investigate a computationally efficient model for determining weather effects on nighttime illumination that includes cloud cover effects on light pollution from cities and military operations.
  - Research a computationally efficient forecast model for surface layer optical turbulence effects and their impacts on target acquisition.
  
  - Conduct field measurements of natural background aerosols in different geographic locations and at different seasons to establish expected backgrounds for bio-aerosols.

Total 3945

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**53A**



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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**74A**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
74A HUMAN ENGINEERING	2478	2662	2765	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides research on soldier performance, including the areas of visual, auditory, cognitive, and stress-related performance. The goal is to identify, describe and manage underlying human-system interface factors critical to the design of Army weapon systems. The barriers include an incomplete understanding of soldier physical, cognitive and perceptual processes and how to apply this understanding to new missions and systems. All of the work in this program is included in the Army Strategic Research Objective (SRO) titled "Enhancing Soldier Performance", and is consistent with the Army Science and Technology Master Plan (ASTMP) and the DOD Basic Research Plan. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2478 - Completed the analysis and documentation of human auditory perception studies on C2 on-the-move and the effect of feedback on auditory skill development.
- Generated an advanced windows-based version of the auditory hazard model with active middle ear muscles and azimuthal correction capabilities.
- Determined that white phosphor night vision goggles (NVGs) afforded recognition of objects at a 15% to 20% increase in target range compared to the standard green phosphor NVGs.
- Provided an analysis of the effects of selective visual attention on target acquisition in static, optically imaged scenes to AMSAA's soldier-in-the-loop target acquisition modeling effort.
- Conducted a survey of infantry soldiers to establish criteria for mission success and associated information requirements in preparation for a field study on the effects of information availability on the performance of dismounted infantry teams.
- Investigated the effects of specific battlefield stressors on situational awareness and decision-making under conditions of uncertainty that resulted in a field-practical set of operational stress measures.
- Identified stress-related predictors and cognitive processes related to performance in an extended complex, novel situation in direct support of the Strategic Research Objective (SRO) "Enhancing Soldier Performance".

Total 2478

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**74A**

## FY 2001 Planned Program

- 2633 - Using the results of previous auditory studies, devise a robust and sensitive speech recognition test specifically applicable to the military environment.
    - Generate hearing protection algorithms and incorporate into Army developed auditory hazard model.
    - Conduct an experiment to examine target and obstacle detection, depth and distance estimation, and size and depth perception with color night vision goggles. This study was delayed from FY00 due to equipment development.
    - Expand studies of selective visual attention on target acquisition to electro-optically (IR and I2) imaged scenes and provide results to AMSAA's soldier-in-the-loop target acquisition modeling effort.
    - Complete field experiment to quantify the effects of the availability of tactical information presented on helmet mounted displays on global and local situation awareness and mission performance of dismounted military teams.
    - Extract findings from intense and novel situations to devise methods for improved information processing and heightened vigilance and awareness within the digitized battlefield.
    - Identify physiological and personality-based correlates of performance, in support of the "Enhancing Soldier Performance" SRO.
  - 29 - Funds reprogrammed for SBIR/STTR programs.
- Total 2662

## FY 2002 Planned Program

- 2765 - Determine the impact of infantry helmet on the auditory localization to provide guidelines for future helmet designs
  - Identify the effects of spectral signal composition on auditory detection and recognition.
  - Conduct research to determine the best approach for improving spatial perception of combat important sounds in adverse listening conditions.
  - Include blast reflection analysis into the auditory hazard model to predict safe use of weapons in urban environments.
  - Form a blast waveform database and include hazard algorithms used by other NATO countries to compare hazard assessments.
  - Modify an existing model of target acquisition performance to include human cognitive inputs in order to improve predictions of soldier and material performance.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**74A**

**FY 2002 Planned Program (Continued)**

- Investigate the effects of display configuration and information format on situation awareness and performance of mission critical tasks.
  
- Apply streamlined, multi-dimensional, stress assessment battery in high workload and high stress environments in order to quantify the stress-performance relationships directly associated with the retention and effectiveness of experienced soldiers.
- Complete studies of electrophysiological measures of cognitive performance and design follow-on studies with Land Warrior perspective.
  
- Generate multivariate and hierarchical models of soldier performance under a variety of stressful conditions.

Total 2765

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**74F**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
74F PERS PERF & TRAINING	2554	2778	2855	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project covers behavioral science research in areas with high payoff opportunities for improved training, leadership, and personnel performance, including: methods for faster learning and improved skill retention; leader effectiveness for improved team and unit 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 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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2554 - Developed leadership model for small, next-century units performing under adversity and techniques for developing the attributes of future leaders.
- Discovered a relationship between military rank and tacit knowledge scores providing support for the importance of tacit knowledge as a predictor of effective performance.
- Completed analysis of how European armies have adjusted to rapid changes in their societies.
- Found that trust in communication may reduce the amount of mutual monitoring, resulting in poorer performance.
- Demonstrated the prediction from Procedural Reinstatement Theory showing that enhancing the difficulty of training improves the durability of the skill and improves skill transfer.

Total 2554

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**74F**

## FY 2001 Planned Program

- 2701 - Determine the effects of computer mediated communication on the effectiveness of leader - subordinate relationships.  
- 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.  
  
- Determine the effects of different types of missions and gender issues on cohesion, morale, and performance effectiveness.  
- Model the results of a long-term analysis on the durability of tank gunnery skills in the absence of practice.  
- Contribute to the development of a cognitive model of the commander by incorporating data on the effects of training on the ability of commanders to handle large amounts of information.
- 77 - Funds reprogrammed for SBIR/STTR programs.

Total 2778

## FY 2002 Planned Program

- 2855 - Evaluate predictions from transformational leadership theory on the effectiveness of training transformational leadership skills.  
- Extend Procedural Reinstatement Theory to predict the unique characteristics of digital skills in terms of their effects on learning, durability, and transferability of trained skills.  
- Construct and validate techniques for developing the particular attributes needed for effective leadership of small units.  
- Incorporate the effects of distance communication discovered in emergency medical operations on models of effective leadership.  
- Develop preliminary results on the effectiveness of cohesion training on team performance.

Total 2855

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**F20**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
F20 ADV PROPULSION RSCH	2423	2487	2611	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The goal of this effort is increased performance of small air-breathing engines and power trains that will support Army Transformation in the areas of system mobility, reliability and survivability, and ultimately serve to reduce the logistics cost burden for the Objective Force. The problems are a need to have much greater fuel efficiency in propulsion systems, and to achieve reduced weight in these systems. Technical barriers for advanced propulsion systems are a limit on the maximum temperature that today's materials can safely withstand, and a lack of capability to accurately simulate the flow physics and mechanical behavior of propulsion systems, including the engine and drive train. 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. Technical solutions are being pursued through analysis, code generation, experiments and evaluations to improve engine and drive train components and investigate advanced materials. Component level investigations include compressors, combustors, turbines, injectors, pistons, cylinder liners, piston rings, gears, seals, bearings, shafts, and controls. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2423 - Validated a first principle centrifugal compressor surge model that points to specific causes for stall and surge instabilities and provides a rational basis for defining new stability-enhancing techniques.
  - Obtained Particle Image Velocimetry measurements of diffuser flow fields in a centrifugal compressor that provided detailed information about the nature and location of flow defects that lead to instabilities. The results were successfully used to design and locate flow injection nozzles in a separate 6.2 program.
  - Completed characterization of the coupling between internal convection and external film cooling for turbine blades. The results will enable more accurate predictions of required cooling flows, lead to more effective use of cooling air, and enhance engine efficiency.
  - Conducted 200 hour combustor durability tests to validate thermomechanical life prediction model for structural ceramics and to identify need for improved environmental coating and composite architecture.
  - Completed acquisition of experimental data for analysis of helical gear thermal behavior, which will lead to reduced rotorcraft drive train weight and improved safety.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**F20**

**FY 2000 Accomplishments (Continued)**

- Assisted industry with extension of gear tooth crack propagation code (National Rotorcraft Technology Center program).
- Conducted mechanical design and structural analysis of wave rotor for a gas turbine topping unit. Wave rotor topped cycles promise substantial improvements in fuel efficiency and power density compared to the baseline cycle.
- Completed application of microelastohydrodynamic lubrication analysis to superfinished gears and completed gear contact stress analysis. Superfinish gears have the potential to substantially extend gear life over conventionally finished gears.
- Investigated ultrasonic wireless data telemetry system based upon piezoceramic transducers to obtain fine spatial resolution measurements of low frequency (100Hz) internal engine physical phenomenology, i.e. pressure, acceleration and vibration.

Total 2423

**FY 2001 Planned Program**

- 2473 - Incorporate environmental effects in life prediction model for advanced structural ceramics, including effects due to combustion products.
  - Obtain detailed measurements of heat transfer and secondary leakage losses of four port through-flow wave rotor and validate loss mitigation approaches to improve the performance and efficiency of future air and ground propulsion designs.
  - Apply and assess validity of newly developed engine weight and safety prediction algorithms. These algorithms will forecast the impact of advanced technologies on the weight and safety of new engines.
  - Validate gear fault detection methodology incorporating sensor fusion for improved rotorcraft transmission safety and reliability.
  - Validate 2D and 3D gear crack propagation codes for improved life and reliability predictions.
  - Use signal processing techniques to improve signal/noise ratio and physical sensing bandwidth for ultrasonic data telemetry data system that more accurately measure and analyze engine phenomena in the 10kHz range.
  - Assess MEMS based concept to implement microblowing and synthetic jets as a nonintrusive approach to active stabilization for centrifugal compressors.
- 14 - Funds reprogrammed for SBIR/STTR programs.

Total 2487

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**F20**

## FY 2002 Planned Program

- 2611 - Construct MEMS based synthetic jet components for application to flow range extension experiments on centrifugal compressor stage.
  - Assess environmental barrier and impact resistant coatings stable to 1480C; incorporate erosion, impact, and environmental effects in life prediction model for advanced structural ceramics for more reliable engine designs.
  - Integrate combustor module into wave rotor external burner experiment and conduct preliminary design of combustor module for wave rotor topped engine.
  - Establish gear design parameters/charts/standards based on crack propagation prediction code to enable lighter weight and more durable drive systems for future rotorcraft.
  - Include elastohydrodynamic effects in the journal bearing performance code to improve performance analysis and predictions which will lead to engines with extended life, greater reliability and durability, and reduced maintenance.

Total 2611



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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H42**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H42 MATERIALS & MECHANICS	1855	1972	2044	0	0	0	0	0	0	0

**A. Mission Description and Budget Item 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 ceramics, advanced polymer composites, advanced metals, and multifunctional materials. These advanced materials will enable lethality and survivability technologies for the Objective Force. This research is conducted by the Army Research Laboratory, at the Aberdeen Proving Ground, MD, and at the NASA Langley Research Center in Hampton, VA, in support of materials technology applied research in project 0602105A/AH84. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1855 - Determined the synthesis-microstructure-property relationships in polymer/clay nanocomposite materials.
- Refined low cycle fatigue predictive models for integrally-designed armor composite materials that include effects of material flaws and damage.
- Investigated processing-microstructure effects on elastic properties of a functionally graded material.
- Extended predictive models and experimental techniques for cluster beam and pulsed laser ablation deposition of protective coatings.
- Investigated and devised coupled theoretical models for constitutive laws governing the high strain rate behavior of lightweight metal alloys and hybrid armor candidate materials.
- Extended numerical and design models of elastomeric structures to include higher order plate and shell finite elements, and evaluated large strain combined loads viscous models against measured data.

Total 1855

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H42**

## FY 2001 Planned Program

- 1955 - Explore novel technologies for energy dissipation in lightweight integrally-designed armor composite materials.
  - Investigate the effects of interfacial chemistry on the morphology development in polymer/polymer and polymer/inorganic nanocomposites.
  
  - Investigate shock response and material damage/failure mechanisms of ballistically impacted ceramics.
  - Determine critical dynamic material properties required for improving the performance of future anti-armor concepts against complex threat armors.
  
  - Evaluate the application of a new computational, elastomeric material modeling technology to intelligent material systems, including electrorheological fluids, which may lead to less costly and more reliable damper systems.
  - 17 - Funds reprogrammed for SBIR/STTR programs.
- Total 1972

## FY 2002 Planned Program

- 2044 - Elucidate the complex microstructural relationships between the interphase and bulk composite properties of lightweight integral armor materials.
  
- Correlate morphology and interfacial properties with mechanical performance in multilayered laminates and layered silicate nanocomposites.
  
- Characterize dynamic and static material properties of advanced ceramics that can be tailored to control the onset of ballistic failure for improved lightweight armors.
- Devise analytic models and experimental techniques for describing material response of dynamically loaded anti-armor concepts.
- Evaluate large strain combined loads viscous models against measured data in cooperative program with Penn State, Brunel University, and Lord Corporation, and investigate the use of these new constitutive theories in the modeling of intelligent material systems, including electrorheological fluids.

Total 2044

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H43**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H43 RESEARCH IN BALLISTICS	3849	4088	4235	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project funds the Army's basic research program in ballistics. The goal is to improve the understanding of the chemistry and physics controlling the propulsion and flight of gun launched projectiles and the flight of missiles, and to understand the interaction of these weapons with armored targets. This research results in the science base which allows the formulation of more energetic propellants, more accurate and lethal projectiles and missiles, and advanced armors for increased survivability of Army combat systems for the Objective Force. This research is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD in support of ballistic technology applied research in project 0602618A/AH80. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3849 - Investigated theoretical chemistry and physics-based models, including 3-dimensional (3-D) ballistics models of future high performance solid propellants, validated models through ignition and combustion experimentation, and predicted mechanical stability, impetus, energy release, flame temperature, and critical intra- and intermolecular propellant properties.
- Coupled computational fluid dynamics/thermal/rigid body dynamics tools for complex aerodynamic shapes and launch dynamics of advanced munitions.
- Incorporated coupled constitutive models into the magneto-solid-mechanics version of the CTH model (a computational solid mechanics model developed by Sandia National Laboratory) being developed as part of the work package on electrodynamic defeat of anti-armor threats.
- Performed shock wave propagation experiments in functionally graded materials to determine the effect of directionality on its shock, release, tensile and energy dissipation properties; Determined the effect of the material property gradient on wave front curvature and amplitude for general directions of propagation.

Total 3849

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**H43**

## FY 2001 Planned Program

- 4023 - Refine fundamental chemistry and physics models and expand experimental techniques to elucidate the factors controlling gun and missile propellant initiation, combustion, sensitivity, and vulnerability.
    - Devise advanced computational models, smart munitions aerodynamic prediction capabilities, and flight vehicle control element design tools for low cost precision munitions.
    - Devise micromechanical model and define theory critical experiments to describe the onset and propagation of damage to ballistically impacted ceramics.
    - Investigate the physical processes associated with adiabatic shear band initiation and growth to improve performance of future anti-armor concepts.
  - 65 - Funds reprogrammed for SBIR/STTR programs.
- Total 4088

## FY 2002 Planned Program

- 4235 - Employ fundamental and 3-D interior ballistics models and experimental techniques to understand the interaction of electrically generated plasmas with propellants and explicitly model shock and detonation propagation in propellant beds.
  - Couple high performance computational design tools to calculate control aerodynamics of smart munitions, missiles, and rocket systems.
  - Expand ceramic micromechanical model to describe intergranular flow, grain size, orientation, and boundary chemistry and conduct fundamental experiments to determine damage evolution under ballistic load.
  - Devise analytic model and conduct fundamental experiments to determine adiabatic shear onset criterion in emerging anti-armor alloys.

Total 4235

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H44**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H44 ADV SENSORS RESEARCH	3866	4106	4243	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project exploits new opportunities in the basic sciences to enable new sensing capabilities for advanced sensors for the Army's Objective Force. This work will produce future generations of sensors with capabilities beyond those currently being employed. Technical barriers include the fundamental speed and bandwidth limitations of current materials and devices, and the efficiency of current algorithms and computing architectures. The focus is on exploitation of digital and image processing modules and algorithms, 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 microoptic elements are investigated 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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1303 - Devised and evaluated iterative algorithms for designing sub-wavelength diffractive optical elements (DOEs).  
- Characterized nonlinear transmission properties of novel material systems such as dendrimers.  
- Achieved single host color phosphors using laser ablation techniques.
- 930 - Established cross-range super-resolution techniques for complex targets with scan-multiple signal classification (S-MUSIC) for improved automatic target recognition (ATR) thereby providing increased lethality for the Objective Force.  
- Completed an analysis of landmine signatures as a function of soil type, imaging geometry and burial depth using electromagnetic models. Results delivered to CECOM's Night Vision and Electronic Sensors Directorate (NVESD) countermines division.  
- Researched wide-band direction finding (DF)-based adaptive beam-forming algorithms and performed preliminary research on Distributed Sensor Array Processing.  
- Showed low leakage currents on Aluminum Nitride thus making it useful for high power, high temperature electronics for the Objective Force.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**H44**

## FY 2000 Accomplishments (Continued)

- 1633 - Utilized fuzzy logic to control level of object detail and to model volumetric objects while maintaining a constant frame rate.  
- Implemented and evaluated techniques for the real-time rectification of sensor imagery utilizing nonlinear and adaptive optics to improve tactical combat imaging systems.

Total 3866

## FY 2001 Planned Program

- 1364 - Integrate nonlinear beam propagation codes to materials properties  
- Record and fix multiplexed gratings in a 3D hologram.
- 1051 - Extend capabilities of S-MUSIC code and nonlinear super-resolution algorithms for radar and validate applicability using field data for improved ATR thereby providing increased lethality for the Objective Force.  
- Evaluate impact of rough surface clutter layer on the radar detection of land mine signatures using electromagnetic models.  
- Investigate and research advanced acoustic classification techniques such as auditory signal modeling and fuzzy logic. Perform research in wide-band adaptive beam-forming and distributed sensor array processing.  
- Investigate the use of aluminum nitride insulator films grown on silicon carbide for high power, high temp switches for electric drive vehicles.
- 1608 - Establish techniques for 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 on tactical communications systems for the Objective Force.  
- Devise algorithms for on-the-fly visual information fusion and processing in the presence of atmospheric turbulence-induced phase distortion effects supporting AMCOM/ARL joint research goals.  
- Provide 4D multigrid microscale nuclear/biological/chemical (NBC) model and enhance multigrid microscale wind model to enable a tactical decision that visualizes chemical effects in context of the physical environment.
- 83 - Funds reprogrammed for SBIR/STTR programs.

Total 4106

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H44**

**FY 2002 Planned Program**

- 1468 - Understand theoretical limits of nonlinear optical materials to provide eye protection from lasers.  
- Understand new display modalities.  
- Demonstrate enhanced organic light emission device lifetimes.  
- Explore limitations of engineered materials to provide eye protection to laser sources.
- 1077 - Determine the effects of noise and clutter on the performance of S-MUSIC for high resolution radars to improve angular accuracy.  
- Report on airborne ground penetrating radar (GPR) utility analysis using knowledge of surface and volumetric clutter.  
- Implement and evaluate efficient encoding and processing schemes between sensor nodes and a centralized gateway.  
- Investigate new advanced target classification techniques that exploit multiple sensor modalities through sensor networks.  
- Improve drive current of voltage controlled switches for high power electric drive vehicles.
- 1698 - Implement and evaluate image processing techniques based on nonlinear spatiotemporal dynamics occurring in large arrays of optoelectronic feedback circuits.  
- Design a prototype of optoelectronic system for moving target tracking from nonstationary platforms, supporting AMCOM/ARL joint research goals.  
  
- Adapt 4-D multigrid microscale NBC model to exploit the Army High Performance Computing Center capabilities and improve the near-real time responses with which the effects of NBC type information is processed.

Total 4243

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H45**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H45 AIR MOBILITY	1880	2016	9096	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides funding for basic research in aerodynamics as applied to rotary wing aircraft. Analysis, code development, and test and evaluation are conducted on rotor-unique aerodynamics, performance, and acoustics. This project supports the Objective Force and Joint Vision 2020 by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1880 - Completed research of stereo image velocimetry technique.
  - Completed detailed rotor wake geometry measurements during blade/vortex interaction using stereo image velocimetry technique.
  - Completed an axial-flight wind tunnel test to separate induced power from total power measurement.
  - Designed and fabricated scale model rotor blades equipped with oscillating blowing to control flow separation.
  - Performed analytic validation of swept tip blade stability characteristics.
  - Conducted parametric studies of active control with on-blade elevons for low vibration rotors.

Total 1880

**FY 2001 Planned Program**

- 1969 - Prepare rotor aerodynamic and acoustic software codes using scalable software.
  - Conduct 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.
  - Design and fabricate a two dimensional (2D) variable droop leading edge airfoil to delay dynamic stall.



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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H45**

## FY 2001 Planned Program (Continued)

- Investigate a new computational fluid dynamics (CFD) tool to design low Reynolds number airfoil using boundary vortex flux technique.

- 47 - Funds reprogrammed for SBIR/STTR programs.

Total 2016

## FY 2002 Planned Program

- 2096 - Perform test to take necessary data for far wake measurement for helicopter and tiltrotor.  
- Gather experimental data to quantify Tiltrotor Vortex ring state measurement.  
- Conduct test of 2D variable droop leading edge airfoil.
- 7000 - Conduct fundamental research for autonomous control of rotorcraft unmanned aerial vehicles.  
- Single Investigator program to research active flow control impact on tiltrotor type aircraft, and research active twist rotor evaluations using neural net closed loop controllers.  
- Using simulation, collect data for synthetic vision database-sensor fusion requirements.

Total 9096

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H47**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H47 APPLIED PHYSICS RSCH	2971	3153	3274	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to investigate the physics of a variety of phenomena occurring in semiconductor materials and structures, including thin heterostructure systems where quantum confinement effects are important. Specifically, this project addresses research to determine carrier transport properties and lifetimes of a variety of important optoelectronic materials and structures, such as those used in high power infrared lasers, detector/modulators for laser radar (ladar), IR detector structures, and eye safe laser sources. Technical barriers affecting performance, weight, cost, and power consumption will be addressed. These investigations will support the development of optoelectronic devices for the Army's Objective Force. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2256 - A cylindrical model of a microlaser cavity, including Q-switch, and a long-pulse microlaser model were established to help design pulsed lasers for ladar and range finders.
  - Modeled enhancement in quantum well infrared photon detector sensitivity using patterned structures.
  - Combined 3-D absorption model with thermal conduction model for IR design of thermal detectors.
  - Completed study of transport properties of type II superlattice heterostructures for lasers and detectors.
- 715 - Formulated new nanophase anode material for next generation (higher specific energy and good low-temperature performance) Li-ion battery for Land Warrior and hybrid power sources for the Objective Force.
  - Synthesized new electrolyte solvents for capacitors and Li batteries with reduced low temperature electrolyte impedance for Land Warrior and hybrid power sources for the Objective Force.
  - Applied combinatorial method for optimization of electrocatalyst compositions for methanol fuel cells for Land Warrior.

Total 2971

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**H47****FY 2001 Planned Program**

- 2493 - Use the microlaser models to predict the threshold and energy output of lasers using various parameters for Er/Yb:glass with given pumping intensities.
    - Determine optical properties of electrically pumped laser and modulator structures.
    - Model antimonide based superlattice and quantum dot IR detectors for high operating temperature.
    - Determine optical and electrical properties of semiconductor superlattice materials.
  - 632 - Authenticate new cathode material for low-temperature Land Warrior primary battery.
    - Synthesize low-flammability solvent for safe Li-ion batteries and capacitors for Land Warrior and hybrid power source for the Objective Force.
  - 28 - Funds reprogrammed for SBIR/STTR programs.
- Total 3153

**FY 2002 Planned Program**

- 2624 - Complete 3-D laser cavity model with passive Q-switch for diode pumped Er/Yb:glass laser, and in collaboration with the Night Vision and Electronic Sensors Directorate of the Communication Electronics Command, compare model with experimental results; prepare report for publication.
    - Complete model of carrier transport in semiconductor superlattice materials based on optical, electrical and magnetic measurements.
  - 650 - Improve the catalysts for hydrocarbon fuel reformer for fuel cells for Land Warrior and hybrid power sources for the Objective Force.
    - Explore materials for ultra-high energy Li/air battery for Land Warrior.
- Total 3274

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H48**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H48 BATTLESPACE INFO & COMM RSC	6447	6863	7118	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project addresses fundamental research in technologies that will enable intelligent and survivable command, control, communication, and intelligence systems for the Objective Force. As the combat force structure becomes smaller and operates in more dispersed formations, information systems must be more robust, intelligent, interoperable, and survivable if the Army is to retain both information and maneuver dominance. The goal of this research is to address the areas of information assurance and the related signal processing for wireless battlefield communications along with intelligent systems for C4I. Major barriers to achieving the goals are overcoming the inherent vulnerabilities associated with using standardized protocols and commercial technologies while addressing survivability in a unique hostile military environment that includes highly mobile nodes and infrastructure, bandwidth-constrained communications at lower echelons, diverse networks with dynamic topologies, high level multipath interference and fading, jamming and multiaccess interference, and information warfare threats. The intelligent systems for C4I research will focus on providing the agent technology capabilities that will reduce the cognitive load on the commander, improve the timeliness, quality and effectiveness of actions and in the long run speed the decision-making process and reduce the size of tactical operation center (TOC) staffs. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3898 - Refined secure mobility management techniques for mobile host protocol that support mobile ad-hoc networking on the move.
- Refined intelligent agents for vulnerability assessment of dynamic tactical networks.
- Evaluated concept for mobile distributed multiple access Anti-Jam (AJ) communication networks for brigade and below.
- Completed investigation of survivable information architectures for information protection that address security, software reliability, data integrity and system recoverability.
- Evaluated and refined hierarchical digital modulation algorithms for classification and identification of signals on battlefield.
- Designed spatial diversity combining algorithms for tactical communications
- Evaluated and refined algorithms for performing channel and source coding for tactical communications that are capable of operating in high bit-error battlefield environments.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H48**

## FY 2000 Accomplishments (Continued)

- 2549 - Validated intelligent agent architecture by testing architecture and alert agent technology in collaboration with the Advanced Battlefield Processing Technology Science and Technology Objective (STO).
  - Documented the critical aspects of human-agent interaction that must be considered in the development of agent applications.
  - Assessed the extensibility and adaptability of the intelligent agent architecture to the synchronization of physical and software agents against a user defined mission plan.
  - Conducted detailed research on the language that will facilitate agent-to-agent communication to expand the theoretical foundations of cooperative intelligent agents.
  - Evaluated the use of soft computing approaches to enhance the ability of agents to deal with uncertainty.
  - Assessed the application of intelligent agent technology to natural language understanding and context tracking.

Total 6447

## FY 2001 Planned Program

- 3888 - Provide efficient algorithms for Internet protocols for highly mobile tactical networks for experimental applications.
  - Review final hierarchical digital modulation algorithms by testing, identifying and classifying complex signals.
  - Utilize a mobile ad-hoc network to interconnect tactical units and higher echelons to show improved information flow.
  - Validate the performance of 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.
- 2855 - Validate intelligent agents for mission planning, rehearsal and status monitoring of a physical agent.
  - In collaboration with the Advanced Battlefield Processing Technology STO, display 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 and agents that monitor the execution of the mission.
  - Validate the performance of natural language and context tracking agents that understand a speaker's intent while visualizing graphical information.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H48**

## FY 2001 Planned Program (Continued)

- 120 - Funds reprogrammed for SBIR/STTR programs.

Total 6863

## FY 2002 Planned Program

- 7118 - Document the improvement in information flow in a mobile ad-hoc network provided by the research suite of networking and control protocols.
  - Extend agent-based wireless network vulnerability assessment research to incorporate secure key management techniques.
  - Determine the fundamental limits on the detection/estimation of modulated signals and the estimation and synchronization of emerging ultra-wideband sources.
  - Investigate techniques to enhance the performance of ad-hoc networks that link unattended microsensors, focusing on routing and control protocols and medium access control algorithms.
  - Provide computational multilingual tools to support tactical, intelligence, and coalition operations that provide language-independent representations of meanings (ontologies) and translingual information search and retrieval.
  - Investigate format representation concepts for federations of ad hoc data management and wireless information distribution schemes to provide a formal representation of military concepts and facilitate coalition operations.
  - Examine the theoretical foundation for cooperating agents architecture and control language by integrating agents that monitor the status of multiple aspects of blue force operations.

Total 7118

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H52**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H52 EQUIP FOR THE SOLDIER	918	975	1014	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports basic research required to achieve the Objective Soldier and the Army Transformation. The research is focused on five core technology areas critical to soldier systems: mathematical modeling, physical performance measurement, polymer science/textile technology, biotechnology and food technology. Research is targeted on enhancing the mission performance, survivability, and sustainability of the soldier by advancing the state of the art in defense against battlefield threats and hazards such as ballistics, chemical agents, lasers, environmental extremes, and rations shortfalls. This project is managed by the US Army Natick Soldier Center, Natick, MA. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 918 - Elucidated photochemical deterioration inherent in nonlinear optical materials used for eye protection.
- Quantified comfort measures for combat clothing to allow rapid improvements in design without impact on function.
- Created models for high strain rates in polymeric fabrics that correlate with predicted failure mechanisms.
- Evaluated biotechnology approaches for developing high performance nanoceramics for lightweight body armor.

Total 918

**FY 2001 Planned Program**

- 973 - Prepare nonspherical and nonlinear nanoparticles and evaluate their potential in improving the strength of composites for use in lightweight equipment to be carried or worn by soldiers.
- Determine if molecular modeling programs correctly predict the one-dimensional strain in polymeric and polymer nanocomposite materials for use in body armor and other protective equipment.
- Correlate military uniform (clothing) comfort with soldier performance by using a variety of clothing performance indicators.
- Evaluate cognitive performance assessment methodologies using cold exposure as a stressor.
- 2 Funds reprogrammed for SBIR/STTR programs.

Total 975

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H52**

## FY 2002 Planned Program

- 1014 - Validate the utility of a model that was created to assist in the design of better methods to carry loads, improving soldier performance.
  - Measure effects of electric fields on the alignment of carbon nanotubes. These materials exhibit properties which suggest they can be used in transparent polymers for eye protection and ballistic shields for body armor.
  - Synthesize antimicrobial peptides to serve as biocides for soldier protection and for ration safety.
  - Transition models on high rate phenomena occurring during ballistic impact events.
  - Validate cognitive testing paradigm for detection of food based performance enhancement under stressful conditions.

Total 1014



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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>				<b>PE NUMBER AND TITLE</b> <b>0601102A - Defense Research Sciences</b>					<b>PROJECT</b> <b>H57</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H57     SCI PROB W/ MIL APPLIC	51095	51086	52697	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This extramural research project seeks to discover and exploit new scientific opportunities and technology breakthroughs, primarily at universities, to improve the Army's Objective Force Capabilities. Current technologies are unable to meet the operational requirements of the Future Combat Systems. The Army Research Office maintains a strong peer-reviewed scientific research program through which leap-ahead technological solutions may be discovered, matured and transitioned to overcome the technological barriers of the Future Combat Systems. Included are research efforts for increasing knowledge and understanding in fields related to long-term Objective Force needs in the physical sciences (physics, chemistry, biology, and materials science), the engineering sciences (mechanical sciences, electronics, and mathematical, computer and information sciences), and environmental sciences (atmospheric and terrestrial sciences). Targeted research programs in nanotechnology, smart structures, multifunctional and microminiature sensors, intelligent systems, compact power and other mission-driven areas will lead to an Objective Force that is more strategically deployable, more agile, more lethal and more survivable. The breadth of this basic research program covers approximately 560 research grants and contracts with leading academic researchers and approximately 1,400 graduate students yearly, and supports research at 192 institutions in 41 states. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 23760 - Devised real-time, 2D Terahertz imaging using free-space electrooptic sampling for security screening and inspection of soldier chemical/biological agent protective suits.
  - Showed quantum-dot superlattice thermoelectric films for use in cryogenic cooling of Forward Looking Infrared (FLIR) systems.
  - Showed that environmentally friendly peroxide chemistry destroys hazardous materials including chem/bio weapons agents.
  - Engineered bacteriorhodopsin mutants enabling macromolecular elements to improve optoelectronics devices and sensors and increase their survivability.
  
- 27335 - Devised a new understanding of combustion dynamics of liquid propellants which has led to redesigned munition fuses for increased safety and reliability.
  - Produced the first Gallium Arsenide 128x128 ultraviolet (UV) focal plane array for missile detection.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H57**

## FY 2000 Accomplishments (Continued)

- Created new software tools for parallel computing making it easier to port applications to new computer architectures and use computer resources more efficiently.
- Established a methodology for integrating topographic data derived from different sensors.

Total 51095

## FY 2001 Planned Program

- 23809 - Produce high impedance ground planes for enhanced performance of GPS, radar, and wireless systems.
  - Optimize beryllium-free amorphous alloy composites which will outperform depleted uranium penetrators.
  - Conduct theoretical chemistry studies of oxygen reduction catalysts to increase efficiency of small fuel cells for individual soldier power systems.
- 25975 - Devise an enzyme-based biosensor to detect anticholinesterase chemical nerve agents and their chemical precursors.
  - Utilize magnetorheological fluid based dampers for improved stability of bearingless helicopter rotorblades.
  - Show a square planar antenna with 1/10 the size of dipole antennas, capable of wider bandwidth and which are conformal thereby reducing the antenna signature on ground vehicles.
  - Devise new classes of smooth bi- and trivariate macroelements for data compressed visualization of open and urban terrain and to calculate chem/bio agent dispersion.
  - Establish a sediment transport model to predict short-term beach conditions for amphibious operations and logistics-over-the-shore.
- 1302 - Funds reprogrammed for SBIR/STTR programs.

Total 51086

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H57**

## FY 2002 Planned Program

- 24412 - Devise ultrasensitive gravity gradiometers to detect underground bunkers and tunnels.
  - Use dendrimer-based polymer composites to provide a solid state solution to sensor and eye protection from laser threats.
  - Adapt enzymes which will detect nerve agents in water.
  - Identify how specific odor molecules, out of many thousands, interact with odorant receptors to detect trace amounts of chemical compounds such as explosives.
- 28285 - Devise a high-fidelity model for fuel combustion and heat release for advanced, low emission/high efficiency gas turbine engines.
  - Devise small footprint parallel Hoffman encoding and decoding at previously unattainable rates for ultra-fast, secure communications.
  - Create high assurance embedded system methodologies leading to improved combat casualty care medical devices.
  - Create robust self-assembled monolayer coatings to ameliorate the adhesion of ice to solid surfaces.

Total 52697

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H66**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H66      ADV STRUCTURES RSCH	1366	1449	1508	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The goal of this effort is to provide improved tools and methods to enable the design and use of composite structures that can better address the cost, weight, performance, and dynamic interaction requirements of future platforms, and ultimately result in safer, more affordable vehicles for the Objective Force supporting Army Transformation. This project is a joint Army/NASA effort that includes structures technology research into: structural integrity analyses; failure criteria; inspection methods which address fundamental technology deficiencies in both metallic and composite Army rotorcraft structures; use of composite materials in the design and control of structures through structural tailoring techniques; rotorcraft aeroelastic and aeromechanical stability; helicopter vibration (rotating and fixed systems); and the design and analyses of composite structures with crashworthiness as a goal. The problems in structures are inaccurate structural analysis and validation methods to predict durability and damage tolerance of composite and metallic rotorcraft structures and inadequate structural dynamics modeling methods for both the rotating and fixed system components to address reliability issues for future aircraft. The technical barriers include a lack of understanding of failure mechanisms, damage progression, residual strength, high-cycle fatigue, the transfer of aerodynamic loads on the rotor to the fixed system, and impact of these unknown loads on aircraft components. Technical solutions are focused in: advanced fatigue methodologies for metallic structures, improved composites technology throughout the vehicle, long-term maturation of an integrated stress-strength-inspection, advanced methods for rotor system vehicle vibratory loads prediction, and improved methods to predict vehicle stability. These advancements will extend service life, reduce maintenance costs, and enhance the durability of existing and future Army vehicles. As agreed under Project Reliance, this is the only project for rotorcraft and ground structures basic research within the DoD. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1366 - Generated an experimental design of the wind tunnel test of twist actuated active rotor system 'open loop' configuration and developed advanced smart structure actuator to reduce rotor vibration and to improve affordability.
- Implemented analytical model including power train dynamics, and explored vibration reduction potential analyses for a tiltrotor configuration.
- Completed assessment of actively controlled stability augmentation for tiltrotor configuration.
- Verified damage resistance and residual strength models that characterize the low velocity impact damage of lightweight composite panels.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H66**

## FY 2000 Accomplishments (Continued)

- Devised 3D finite element analysis with coupled tension/torsion loading to predict strength and life of flexbeam laminates.
- Investigated structural parameters that influence damage progression in new composite materials.
- Extended Mode II & III and Mixed Mode I & II delamination fracture criteria to include fatigue durability, which will lead to vehicle designs with improved structural integrity.

Total 1366

## FY 2001 Planned Program

- 1444 - Conduct wind tunnel tests to study the forward flight characteristics of a twist actuated active rotor system in 'open loop' configuration and to investigate the design of 'closed loop' configured experiments. This work will enhance vibration control in advanced rotorcraft.
  - Conduct analyses on control laws for the closed-loop Active Twist Rotor, and devise actuator concepts for the second generation. This will lead to improved vibration control and aerodynamic performance of future advanced rotorcraft.
  - Incorporate active control and smart material analytical models into a comprehensive analysis that will result in improved vibration and stability predictions for advanced rotors.
  - Perform aeroelastic response studies of active stability controlled tiltrotor systems, and modify analytical tools to allow for a complete modeling of the Quad Tiltrotor concept.
  - Research improved damage growth prediction methods to better understand skin/stringer failure modes and to enhance structural reliability of future rotorcraft platforms.
  - Complete crippling tests to validate strength and durability predictions for damaged carbon-rod reinforced structures, which will provide for more accurate life usage and maintenance forecasts of current and future Army platforms.
  - Prepare draft test standards for mode 2&3 and mixed-mode 1&2 delamination onset criteria which will promote improved composites fatigue durability of future Army platforms.
- 5 - Funds reprogrammed for SBIR/STTR programs.

Total 1449

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**H66**

**FY 2002 Planned Program**

- 1508 - Investigate advanced macrofiber composite actuator concepts (greater strain capability, but at a reduced cost) to support the Low Cost Active Rotor (LCAR) program. These concepts may eliminate the need for the heavy, bulky, maintenance-intensive, swashplate rotor from future Army rotorcraft platforms.
- Evaluate forward flight characteristics of twist actuated active rotor system in 'closed loop' configuration to help reduce rotor vibration.
- Correlate tiltrotor analysis with wind tunnel test data to validate improved vibratory loads prediction capability.
- Couple human occupant models and transient dynamic Finite Element simulation of vehicle crash tests to improve prediction of occupant exposure loads and survivability in Army aviation platforms.
- Validate design criteria for skin/stringer failure models to promote structural reliability and durability of future Army rotorcraft designs.
- Investigate delamination characterization test standards for hybrid and angle-ply composite laminates for improved structural integrity of future advanced rotors.
- Conduct experiments to understand interaction of delamination and curvature for low-velocity impact damage, in order to provide improved future design guidance for air and ground vehicle industry.
- Expand fatigue life predictive methods to incorporate probability distributions for bounding metallurgical flaw sizes, which will improve the accuracy of future platform designs.

Total 1508

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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0601102A - Defense Research Sciences</b>						<b>PROJECT</b> <b>H67</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H67 ENVIRONMENTAL RESEARCH	3342	3537	3644	0	0	0	0	0	0	0

**A. Mission Description and Budget Item 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% versus 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. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3342 - Optimized the environmentally benign CL-20 synthesis process for use in bench scale evaluations.
- Developed model and tested large caliber Cylindrical Magnetron Sputtering target configurations.
- Evaluated biodegradable materials for incorporation in montmorillonite clay nanocomposites produced by melt extrusion (solvent-free) methods.
- Completed studies of self-assembled monolayer-topcoat adhesion and the use of plasma surface treatment for improved adhesion.
- Developed Soil Ecotoxicological Database for labile CW agent compounds and related compounds in soil, based on soil bioassay measurements.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**H67**

## FY 2000 Accomplishments (Continued)

- Developed an economical manufacturing process for single crystal tungsten alloys and validate the performance of single crystal tungsten penetrators.

- Developed supercritical fluid parameters for processing pyrotechnic binders.

Total 3342

## FY 2001 Planned Program

- 3451 - Produce CL-20 and military grade 2,4-dinitrotoluene at bench scale using new environmentally benign processes.
  - Apply selected coatings to medium and large caliber gun tubes that 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.
  - Compare the chemical resistance and physical/thermal properties of monolayer topcoats to with heavy-metal based primer-topcoat systems.
  
- 86 - Funds reprogrammed for SBIR/STTR program.

Total 3537

## FY 2002 Planned Program

- 3644 - Scale up ceramic production using conditions determined to produce desirable materials and investigate processing variables.
  - Develop initial predictive capabilities for labile CW agent materials in soil.
  - Characterize factors important for extending the lifetime of present gun barrels and accelerating the introduction of environmentally friendly coatings.
  
- Characterize PCL/clay nanocomposites processed as blown films.

Total 3644



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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>				<b>PE NUMBER AND TITLE</b> <b>0601102A - Defense Research Sciences</b>					<b>PROJECT</b> <b>S13</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
S13 SCI BS/MED RSH INF DIS	8576	9100	9410	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports focused research for healthy, medically protected soldiers in support of the "Medical" technology area of the Objective Force. Research efforts focus on investigation of medical countermeasures for naturally occurring diseases that are militarily significant due to their historically severe impact on military operations. Establishment of medical countermeasures will protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations. Intramural research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Medical Research Institute of Infectious Diseases, the Walter Reed Army Institute of Research and its overseas laboratories, and the Naval Medical Research Center and its overseas laboratories. Major contractors are The Institute for Genomics Research, Rockville, MD; Harvard University, Cambridge, MA; and the University of Alabama at Birmingham, AL; and the Armed Forces Research Institute of Medical Science, Bangkok, Thailand. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3865 Conducted basic research to support prevention and treatment of malaria.
  - Completed sequencing of nearly 10 million base pairs of DNA sequence on three entire chromosomes from human malaria parasite Plasmodium falciparum. This also resulted in the identification of two novel targets for antimalarial drug discovery. Identified over 100 new sporozoite antigens, which are potential candidate vaccine components.
  - Identified Plasmodium vivax malaria parasite production and sequencing strategies that should allow for the rapid and inexpensive sequencing of additional malaria parasite genomes and began evaluating the P. vivax sequencing strategies, critical in developing vaccines and drugs for protection of soldiers from multiple types of malaria.
  - Determined that volunteers immunized and protected by prototype malaria vaccine RTS,S had immune response patterns distinct from non-protected volunteers.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**S13**

**FY 2000 Accomplishments (Continued)**

- Identified new chemical entities that selectively target and disrupt essential enzymes or pathways in the malaria parasite's life cycle. Expressed, purified, and crystallized specific malaria enzymes that were identified as key targets for structure-based drug design. Determined three-dimensional x-ray structure of the enzymes, which provided critical information to design more effective antimalarial compounds. Investigated a novel liver cell line that permits culturing vivax malaria parasites at a high density, which will provide a sufficient source of parasites for drug screening tests.

- 1321 Conducted basic research to support prevention of diarrheal diseases.
  - Identified new proteins from strains of the bacteria Enterotoxigenic Escherichia coli (ETEC) found in Egypt that block the ability of this organism to establish itself in human intestines and cause diarrhea. Genetically produced these proteins with the goal of testing them as a vaccine that ultimately could be broadened to also protect against bacterial diarrhea caused by Shigella and Campylobacter. Determined the procedures for producing ETEC bacteria under Good Manufacturing Practices (GMP) conditions, for use in determining effectiveness of ETEC vaccines in human volunteers as required by the Food and Drug Administration (FDA). Compared genetic sequences from Shigella to E. coli as sequences became available in Internet databases with the purpose of determining similarities in genes that cause diarrhea to investigate common vaccine targets. Conducted genetic sequencing in targeted regions of Campylobacter DNA and compared results to published Campylobacter sequences of different organism strains to detect which genes are most important in causing disease.
- 1950 Conducted basic research to support prevention of Group B Neisseria meningitis, Hepatitis E virus (HEV), and scrub typhus and to develop rapid diagnostic tests and insect control measures.
  - Studied the immunology of HEV infection in pregnancy to assist with vaccine study design and resulting interpretation. Studied epidemiology of HEV infection in an Egyptian adult population residing in a HEV endemic area. Evaluated the risk of HEV exposure for travelers to endemic areas to define military operational threat, design vaccine studies, and develop doctrine for vaccine use. Determined protective antibody levels in Hepatitis E virus (HEV) disease using an animal model and human intravenous immune globulin. Genetically modified a capsule-negative strain of Group B meningococcal bacteria to decrease reactogenicity and to stabilize a high level of an immunogenic outer membrane protein for use as a candidate vaccine. Developed a Geographic Information System to assess the threat of malaria transmission by the Anopheles dirus mosquito. Studied rapid nucleic acid-based tests as a potential diagnostic product to identify dengue virus, Campylobacter, and drug resistance in Shigella.
  - Assessed feasibility of sequenced strain-specific antigens for a candidate scrub typhus vaccine.
- 1440 Conducted basic research to support prevention of viral diseases.
  - Identified factors that predict safety and a long-lasting immune response that will provide selection criteria for the best dengue vaccine candidate. Studied epidemiology of hantaviruses in South America and Indonesia to assess risk of infection to deployed soldiers. Identified diagnostic tests for encephalitic and hemorrhagic viral diseases.

Total 8576

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

June 2001

**BUDGET ACTIVITY**  
**1 - BASIC RESEARCH**

**PE NUMBER AND TITLE**  
**0601102A - Defense Research Sciences**

**PROJECT**  
**S13**

**FY 2001 Planned Program**

- 5622 Conduct basic research to support prevention and treatment of malaria.
    - Produce *P. falciparum* parasites for all Department of Defense (DoD)-sponsored genome sequencing efforts. Develop and implement methods to close sequencing gaps. Assist the DoD malaria consortium to construct and verify genetic maps.
    - Validate a rapid, high throughput approach to malaria vaccine development that capitalizes on the *P. falciparum* genomic sequence data. Characterize stage-specific protein expression and location within the malaria parasite to reveal new targets for vaccine and drug development.
    - Identify markers of protective immunity to malaria in naturally exposed populations and also in response to candidate malaria vaccine proteins.
    - Define the epidemiology of severe anemia in northern Ghana to assess that location as a vaccine field trial site.
    - Identify additional new malaria drug targets and mechanisms of the parasite's drug resistance using molecular genetics. Synthesize quantities of drug candidates for safety and efficacy evaluation.
  - 816 Conduct basic research to support prevention of diarrheal diseases.
    - Evaluate the immune response to ETEC infection in United States military personnel on deployment in Egypt to predict the effectiveness of candidate ETEC vaccines. Compare different strains of *Campylobacter* by analyzing proteins and genetic sequences, identifying factors by which these organisms cause disease to determine the best candidates for vaccine development. Identify previously unidentified proteins that allow ETEC to adhere to the gut and cause disease. Study epidemiology of diarrheal disease in Peru to assess that location as a future vaccine field trial site.
  - 1379 Conduct basic research to support prevention of HEV infection and evaluate rapid diagnostic tests and insect control measures.
    - Assess risk of non-A-E acute hepatitis in Southeast Asia to determine the threat to deployed warfighters. Assess the epidemiology of tick-borne diseases in Egypt and malaria in Thailand and Western Kenya to determine risk and recommend control measures in areas to which our troops may deploy. Identify mosquito species that carry malaria in diverse regions of Africa (high altitude, urban, dry season) to develop vaccine study sites. Develop a standardized system for assessing dengue risk based on surveillance for adult mosquitoes that transmit dengue virus in Southeast Asia. Validate DNA-based tests for the identification of militarily important pathogens from Southeast Asia.
  - 1109 Conduct basic research to support prevention of viral diseases.
    - Determine if immune response to a previous dengue infection is related to severe dengue disease in a subsequent infection, which will help in designing a safe dengue vaccine. Validate a rapid, high throughput, DNA-based test to measure effectiveness of dengue candidate vaccine.
  - 174 Funds reprogrammed for SBIR/STTR programs.
- Total 9100

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**S13**

**FY 2002 Planned Program**

- 5962 Investigate new/improved prevention methods and treatment for severe and complicated malaria necessary for protecting and restoring the health of soldiers.  
 - Begin genomic sequencing of vivax malaria DNA to support vaccine development against this second most militarily important cause of malaria in ground soldiers.  
 - Produce a threat assessment for malaria drug resistance for the Commanders-in-Chief (CINCs) so that they can determine the best preventive measures to protect their soldiers.  
 - Discover novel compounds that inhibit essential enzyme pathways in the malaria parasite and thus are potential antimalarial drug candidates. Identify additional new malaria drug targets and mechanisms of the parasite's drug resistance using molecular genetics. New drugs are continually needed to stay ahead of drug resistance that the malaria parasite develops, so that ground forces will be protected from, or can be successfully treated for this disease.
  
- 1255 Investigate new/improved prevention methods against diarrheal diseases needed to protect and restore the health of soldiers.  
 - Conduct epidemiological studies to define the military operational impact and relevance of infection with Norwalk virus and Norwalk-like viruses to determine if a vaccine development effort against this cause of diarrhea is necessary.
  
- 1109 Conduct basic research to support prevention of disease from scrub typhus and adenovirus infection to ensure there is no adverse operational impact from these diseases on our forces. Design rapid diagnostic tests for identification of scrub typhus and adenovirus. Identify insect control measures for prevention of scrub typhus. Define the range of Orientia tsutsugamushi natural strain variations that would affect immune responses to these organisms that cause scrub typhus in order to determine the necessary components of a broadly protective vaccine. Assess the epidemiology of insect-borne diseases to determine risk and recommend control measures in areas to which our troops may deploy.
  
- 1084 Conduct basic research to determine if vaccine development efforts to prevent against additional viral causes of disease are necessary. Conduct epidemiological studies to define the operational impact and relevance of flavivirus infections, especially West Nile virus and tick-borne encephalitis virus. Conduct epidemiological studies of hantaviruses to identify potential vaccine field-test sites. Identify potential drug or biological product candidates that could prevent and/or treat infection caused by Lassa virus.

Total 9410

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**S14**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
S14 SCI BS/CBT CAS CARE RS	3770	4005	4135	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports focused research for healthy, medically protected soldiers to understand the basic mechanisms of combat-related trauma in support of the "Medical" and "Future Warrior" technology areas of the Objective Force. This research identifies trauma-related topic areas for basic techniques and the experimental models necessary to support in-depth trauma research studies. Research conducted under this project forms the basis for the advancement of trauma treatment and surgical procedures to delay cell death and reduce bleeding following traumatic injury, minimize lost duty time from minor battle and non-battle injuries, and provide military medical capabilities for far-forward medical/surgical care of battle and non-battle injuries. Intramural research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Walter Reed Army Institute of Research and its overseas laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 995 Conducted basic research to reduce the logistical burden of blood products on the battlefield by assessing new blood storage bags and freeze-drying strategies for plasma. In contrast to previous experiments, the resulting freeze-dried plasma exhibited higher blood clotting factors. These factors are needed to control hemorrhage.
- 889 Conducted basic research to enhance the resuscitation capabilities for combat medics by evaluating biologics for their capabilities to protect wounded combatants from the after effects of wounding and severe blood loss. These included modified hemoglobin, complement activation inhibitors, intracellular protein regulators, and antisense deoxyribonucleic acid (DNA) to decrease lung damage from excessive mucus production following smoke inhalation on the battlefield.
- 1190 Conducted basic research on novel methods to repair and prevent hard and soft tissue injuries by investigating the properties of bones and bone fixator pins to reduce fractures and to prevent post-op infection in bones under field conditions. Assessed the bacteria-killing activity of a synthetic biological agent (peptide) as a potential antiplaque agent to reduce dental disease.
- 696 Conducted basic research on the physiological effects of bleeding to improve patient outcomes. Established improved hemorrhage models for use in developing products, techniques, and guidelines for hemorrhage control on the battlefield.

Total 3770

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**S14**

**FY 2001 Planned Program**

- 1817 - Conduct basic research to enhance the resuscitation capabilities for combat medics by examining the activation and inhibition of inflammatory proteins in tissues to assess whether their control can limit the extent of injury after trauma.  
- Identify human cell protective agents that can be added to resuscitation fluids to protect against injury due to hemorrhage and other trauma. Investigate methods to measure retinal vessel blood oxygen saturation to diagnose hemorrhage severity and better triage wounded soldiers.
  - 1216 Conduct basic research on novel methods to repair and prevent hard and soft tissue injuries by testing germ-killing biologics to improve wound healing and prevent oral infection. Test sustained-release reactive oxygen inhibitors and growth factor to improve wound healing therapy and decrease morbidity. Study head injuries caused by bullets striking helmets to evaluate potential head and neck injuries expected on the battlefield.
  - 884 Conduct basic research on novel methods to reduce the damaging effects of brain injuries by testing neuroprotective drugs that reduce the after effects of blood loss to brain tissues.
  - 88 Funds reprogrammed for SBIR/STTR programs.
- Total 4005

**FY 2002 Planned Program**

- 1099 Conduct basic research to enhance the resuscitation capabilities for combat medics by evaluating the extent of inflammation in blood vessel dysfunction. Conduct further research to identify human blood vessel protective products that can be added to resuscitation fluids to protect against injury due to hemorrhage and other trauma.
  - 1239 Conduct basic research on novel methods to repair and prevent hard and soft tissue injuries by conducting research to identify and develop compounds capable of arresting primary and/or secondary colonization of the mouth by germs that cause gum disease. Determine the best methods to treat and/or stabilize penetrating extremity trauma at far-forward locations to improve battlefield mortality/morbidity rates.
  - 897 Conduct basic research on novel methods to reduce the damaging effects of brain injuries by testing drugs with anti-inflammatory actions that act by blocking pathways to reduce inflammation after hemorrhage.
  - 900 Conduct basic research to produce physiological sensors and devices aimed at diagnosing and treating injuries. Investigate methods to assess at a distance how severely a soldier is wounded and whether a casualty is alive or dead to reduce exposure of medics to enemy fire. Study methods for noninvasively assessing the presence of air or fluid in chest/abdominal cavities to deliver life-saving treatment far forward.
- Total 4135

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

**June 2001**

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**S14**

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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0601102A - Defense Research Sciences</b>						<b>PROJECT</b> <b>S15</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
S15 SCI BS/ARMY OP MED RSH	5129	5445	5631	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports focused research for healthy, medically protected soldiers, and funds research consistent with the "Medical", "Survivability", and "Future Warrior" technology areas of the Objective Force. This research will develop medical countermeasures to sustain performance when the opportunity for adequate rest is impaired or impossible due to combat conditions. 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 on 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 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 Strategic Research Objective (SRO) on "Enhancing Soldier Performance." Intramural research under this project is conducted at the following U.S. Army Medical Research and Materiel Command laboratories: the Aeromedical Research Laboratory, the Research Institute of Environmental Medicine, and the Walter Reed Army Institute of Research and its overseas laboratories. Major contractor is McKesson Incorporated, TX. Additionally, numerous Cooperative Research and Development Agreements (CRDAs) are held with universities and independent laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1690 Discovered non-thermal effects of ultra-wide band radio frequency radiation, which produced a progressive hypotension in rats. This is important because ultra-wide band combat systems are currently being developed and no previous studies of bioeffects and potential hazards have been conducted.
- 645 Expanded the database for the Automated neurological Assessment Metric (ANAM) on cadets from the United States Military Academy and airborne soldiers. This test is important to the measurement of subtle changes in motor function for which other neuropsychological tests are insensitive.
- 1029 Created assay techniques to detect coliform bacteria and toxic agricultural pesticides in food and water within four hours, and the useful application of the Frog Embryo Toxicity Assay for identifying toxic chemical compounds and mixtures that are reproductive health risks. This will provide a rapid assessment of water based environmental hazards.



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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**S15**

**FY 2000 Accomplishments (Continued)**

- 1000      Evaluated the effects of potential treatment candidates for reducing effects by induction of hypothermia and rewarming in animal models.
  
  - 765      Determined, through the use of neuroimaging techniques, the regional brain activity associated with sleep deprivation, identifying specific brain targets for reactivation. This will guide the development of the most effective future countermeasures to diminished performance resulting from sleep deprivation.
- Total    5129

**FY 2001 Planned Program**

- 943      Improve precision methods for studying changes in behavior and in physiological endpoints resulting from non-thermal energy absorption of radio frequency radiation. This helps research that guides materiel developers for future combat systems, body worn antenna, etc., to avoid biologically harmful frequencies and power mixes.
  
  - 924      Explore the feasibility of combined amino acid/carbohydrate supplements on the enhancement of muscle strength through effects on muscle metabolism in men and women.
  
  - 982      Identify the role of antioxidant stress and responses to antioxidant interventions to reduce delayed onset of muscle soreness, musculoskeletal tissue damage and performance decrements associated with strenuous and prolonged training. This will lead to preventive strategies to maximize performance and minimize injury.
  
  - 549      Explore the development of endpoints to detect DNA reactive effects on the different stages of sperm and egg development and detect effects on offspring resulting from parental operations exposures to reproductive toxins. This research will provide a better understanding of the reproductive effects of environmental toxins encountered in operational environments, enabling the development of more effective countermeasures to such exposures.
  
  - 1059     Explore functional magnetic resonance imaging techniques to evaluate brain activity while performing cognitive tasks under sleep deprivation to demonstrate effectiveness of proposed future countermeasures.
  
  - 889      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. These interventions will save costs from medical treatment and lost duty time from stress fractures and also improve long-term health of soldiers protecting them against osteoporosis later in life.
  
  - 99        Funds reprogrammed for SBIR/STTR programs.
- Total    5445

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**S15**

## FY 2002 Planned Program

- 5631 - Explore the combined effects on behavior resulting from non-thermal energy absorption of radio frequency radiation and exposure to environmental toxins. This research will reduce the incidence of injuries due to non-thermal battlefield radiation.
- Determine if muscle injury and inflammatory response impairs thermoregulation and risk of hypothermia in cold. This research program objective will support the Objective Force by preventing non-freezing cold injuries during deployments to adverse environments.
- Investigate genomic or proteomic levels to facilitate development of bioreporters of reproductive effects utilizing reporter gene technology. This research will aid in the identification of environmental hazards during deployment of the Objective Force.
- Explore brain imaging as a technique to determine relationships between fatigue, vigilance, and sleepiness. This research will enhance the cognitive performance of the warfighter during sustained operations.
- Conduct a study on the effects of combined essential amino-acid/carbohydrate supplements on the development of muscle strength in women and men recruits during initial entry military training. This research program objective will provide direct support to the Objective Force by enhancing survivability of soldiers in adverse environments through the use of metabolic regulators.

Total 5631

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**T22**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T22 SOIL & ROCK MECH	1759	1870	1923	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to develop the fundamental knowledge base required by the Army in the field of civil engineering to directly support the Chief of Staff of the Army's initiative to transform the Army into a more responsive, deployable, agile, versatile, lethal, survivable, and sustainable force. Emphasis is on: (a) developing new materials that provide greater ballistic, impact, and penetration protection; signature manipulation for camouflage, concealment, and deception; and expedient construction and repair of vehicle and aircraft operating surfaces; (b) defining constitutive behavior and penetration mechanics associated with projectile impact on complex geologic and structural materials; mathematical models for first-principle analyses of explosive-induced ground shock and high-velocity projectile impact; and (c) determining and quantifying the complex response of deformable soils to transient loading resulting from high-speed curvilinear vehicle maneuver. These technologies provide the basis for applied research that supports: the deployment of a brigade in 96 hours, a division in 120 hours, and five divisions in 30 days by providing analytical capabilities for mobility assessments; expedient battlefield protection; terrorist protection from asymmetric threats; signature management for camouflage, concealment, and deception; and advanced vertical and horizontal construction material in program element 0602784A, project T40. The work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1759 - Incorporated projectile erosion algorithms into penetration prediction codes to support the Army Transformation.
- Developed theoretical formulation for penetration of wheels into partially saturated soils during cross-country movement enabling accurate assessment and prediction of maneuver for future warfighting scenarios.
- Developed analytic model describing influence of partial soil saturation on surface shear strength which ultimately impacts throughput and maneuver.
- Verified constitutive models for asphalt pavement materials and implemented constitutive models for granular materials into an advanced pavement system model for accurate and reliable assessment of airfield performance prediction.

Total 1759

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**T22**

## FY 2001 Planned Program

- 1815 - Develop finite element approach for response of target joints and fractures to projectile penetration to support the Army Transformation.
    - Model soil response to transient loading patterns of wheeled and tracked vehicles.
    - Evaluate pavement interface, load, dynamic response, and traffic distribution models to realistically represent future aircraft effects on pavement performance.
    - Determine appropriate combinations of responsive/passive composite materials for camouflage, cover, and deception as a function of environment and facility.
    - Determine physics of fiber-soil interaction that facilitates increased soil stability and enables rapid airfield and lines of communication (LOC) construction.
  - 55 - Funds reprogrammed for SBIR/STTR program.
- Total 1870

## FY 2002 Planned Program

- 1923 - Apply an improved Hybrid Elastic-Plastic Model to rock targets to support the Army Transformation.
    - Develop experimental quantity of responsive/passive camouflage, cover, and deception material.
    - Develop physics-based damage models for incorporation into accurate and reliable pavement performance for future aircraft.
- Total 1923

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**T23**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T23 BASIC RES MIL CONST	1487	1581	1626	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports research in fundamental understanding of long-term durability of composite materials, behavior of structural elements, and collaborative design to support the Army Transformation. The project invests in research that will lead to leap ahead technologies to solve military-unique problems in the planning, programming, design, construction, and sustaining of deployed facilities (buildings, etc.) and energy and utility infrastructure. This project supports exploratory development efforts in program element 0602784A, projects T41 and T45. The work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1487 - Developed fundamental understanding of the behavior of structural connections under high cyclic loads (like earthquakes).
  - Analyzed experimental data for the development of response algorithms for frame and shear walls to tri-directional earthquake loading.
  - Completed lab testing of prototype models for determining structural health using Electro Time Domain Reflectometry (ETDR) techniques.
  - Developed and validated models for the energy dissipation capacity of steel based on fatigue life.

Total 1487

**FY 2001 Planned Program**

- 1534 - Complete axiomatic collaboration design theory to facilitate design automation.
  - Develop analytical model for the non-linear response of dual structural systems to seismic inputs.
  - Develop micro-mechanical failure models for infrastructure Fiber Reinforced Polymer (FRP) composite materials.
- 47 - Funds reprogrammed for SBIR/STTR program.

Total 1581

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**T23**

## FY 2002 Planned Program

- 1626 - Develop perspective-based semantic mappings to increase understanding of the fundamental principles of scalable information architecture.
  - Develop individual material property degradation models for long-term performance modeling of structural composite elements.
- Total 1626

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**T24**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T24 SNOW/ICE & FROZEN SOIL	2080	2413	1207	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project is the only focused Department of Defense basic research effort 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. Objective Force lethality and survivability will be enhanced by exploiting advanced sensor capabilities facilitating standoff engagements in all types of terrain and in all seasons. Characterization of the battlespace environment and forecasting the state of the terrain will enable the Objective Force to fully exploit emerging sensing capabilities and achieve superior mobility and survivability. Research focuses on material characterization, physical and chemical processes, and energy propagation applicable to predicting state of the terrain, the effects of the environment on target and target background signatures, and future mobility enhancements in support of the materiel development community. It provides the knowledge base for understanding and assessing environmental impacts critical to battlespace visualization. This work is managed by the U. S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2080 - Investigated small-scale heterogeneity for state-of-the-art snow/ground modeling to improve the energy balance methods for computing snowmelt and flow through soils.
- Analyzed spatial variability of icing processes to enhance the design and doctrine for lines of communications and air operations.
- Determined efficiency of snow as a filter for chemical particulates that would protect the soil/ground if subjected to a chemical attack.
  
- Identified cold unique conditions for Homeland Security issues such as bio-terrorism and chemical agent releases that need to be considered when designing methods to combat such threats.

Total 2080

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**T24**

## FY 2001 Planned Program

- 1137 - Develop a model for parameterizing the boundary layer turbulent energy exchange over snow for validating sensor design parameters and performance expectation.  
- Investigate background seismic and acoustic wave propagation in snow-covered and frozen ground urban terrains for use with wide area mine technology sensors for targeting.  
- Determine the effectiveness of current decontamination solution "decon green" to destroy surrogate bio/chemical agents (anthrax type spores) in a winter environment for battlefield and Homeland Security areas.
- 1209 - FY2001 Congressional add to enable research for characterization of cold weather process impacts on Objective Force materiel, operations and facilities.
- 67 - Funds reprogrammed for SBIR/STTR program.

Total 2413

## FY 2002 Planned Program

- 1207 - Develop a new snow deformation modeling approach using the discrete element technique to improve mobility predictions in snow.  
- Measure radiometric properties of battlefield materials in the 35-100 mm wavelength for use as an airborne and or targeting sensor.  
- Determine military unique seismic/acoustic signatures to improve Wide Area Mine (WAM)/Raptor performance in urban areas with snow covers.  
  
- Improve the performance of decon solutions for attacking chemical agents (anthrax type spores) in winter environments.

Total 1207



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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**T25**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T25 ENVIRONMENTAL RES-COE	4195	4461	4590	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide the basic research needed to develop the technologies to address Army issues in the restoration, compliance, conservation, and non-industrial 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. Compliance and pollution prevention efforts address knowledge gaps for troops installations and compliance at 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. 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 program element 0602720A, projects F25, 048, and 896. Funds in this project are used to support basic research via university contracts for in-house laboratory efforts. The work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4195 - Investigated photocatalytic destruction mechanisms for nitroaromatic compounds which are highly explosive in nature and are present in multiple types of Army waste streams.
- Identified and isolated enzymes that degrade Royal Demolition eXplosive (RDX) and High Melting eXplosive (HMX) for use in developing an enzyme-based reactor to treat explosive contaminated wastewater.
- Investigated non-linear theories for low frequency, rigid-frame absorbers to build corresponding analytical models for noise mitigation in the near field from blast waves caused by large weapons noise mitigation.
- Developed a protocol to predict reaction rates for a new treatment process to destroy explosive contaminants in wastewater.
- Investigated field condition microbiology that defines the interrelationships between soil microbial composition and the effect on plant community growth, reproduction, and recover from external stresses.
- Completed investigation of the fundamentals of magnetic and electromagnetic induction spectroscopy and pan-spectral electromagnetic sensing to support enhanced discrimination and identification of buried unexploded ordnance.
- Completed a description of how micro-organisms that have ecologically adapted themselves to cold regions environments cause the major explosives types to biologically degrade into different types of chemicals.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**T25**

## FY 2000 Accomplishments (Continued)

- Completed the determination of the phenomenology for predicting Non-Aqueous Phase Liquid (NAPL) interfacial properties and multiphase soil hydraulic properties using computational molecular thermodynamics for a better understanding of how it may be possible to degrade and treat this fuel and solvent residue that can not be broken down and treated by conventional means.
- Determined mechanisms of adsorption and transformation of explosives in low carbon aquifer soils for the later (applied) development of physical and biological treatment methods under these less conditions that are currently difficult to address.
- Investigated the means by which to identify/characterize the types of micro-organisms in the ground by way of how/what they breath to aid in the development and use of biological in-situ treatment processes.

Total 4195

## FY 2001 Planned Program

- 4328 - Complete investigation of bacterial enzymes for biodegradation of nitroaromatics identifying RDX-digesting bacteria from a munitions wastewater treatment plant for use in next-generation biodegradation technologies.
- Evaluate RDX and HMX biodegradation under identical conditions and excess hydrogen to determine the resistance to biodegradation that might hinder the degradation process.
- Identify physiological indicators of stress in surrogate endangered bird species to develop cost-effective techniques to evaluate effects of military training on federally-listed endangered species.
- Complete determination of fundamental mechanisms of how soils erode under soil freeze/thaw conditions.
- Complete determination of genetic characteristics of native plants in cold regions for use in developing improved training range erosion control methods.
- Complete description of the fundamental mechanisms by which micro-organisms biologically stabilize (restrict the movement and chemical transform to more hazardous chemicals) of Polycyclic Aromatic Hydrocarbons (PAHs) for soils and sediments where the nitrogen content has been reduced/eliminated.
- Complete the determination of ratios  $^{15}\text{N}/^{14}\text{N}$  ratio of TNT versus the concentration of TNT in environmental systems to develop improved and less costly means of chemical analysis of TNT.
- Investigate other concepts by which to identify/characterize the types of micro-organisms in the ground by way of how/what they breath to aid in the development and use of biological in-situ treatment processes.
- Explore the fundamental behavior of micro-organisms when introduced as part of zero-valent iron in-situ contaminant treatment systems.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601102A - Defense Research Sciences**

PROJECT

**T25**

## FY 2001 Planned Program (Continued)

- Determine the dielectric and conductive properties of contaminated fine-grained sediments to provide the bases for the development of improved tools to characterize contaminated sites and to support the development of improved explosives treatment processes.
- Investigate basic principles required to determine if simple, on-site soil invertebrates assays can be used to tell if explosives are present in soils.
  
- Develop micro-scale methods for the identification of TNT and TNT biologically rendered byproducts in soil for the development of improved characterization methods and to support the development of improved explosives treatment processes.
- 133 - Funds reprogrammed for SBIR/STTR program.

Total 4461

## FY 2002 Planned Program

- 3338 - Complete non-linear theories for acoustic behavior in the near-field from blast wave for use in predicting noise absorption using corresponding analytical models for noise mitigation in the near field from blast waves caused by weapons noise mitigation.
- Initiate field evaluation of physiological response and habituation of endangered bird species to military stressors to assess relative effects of military training disturbance, environmental variability and geographic variability in physiological stress response of federally-listed endangered species.
  
- Determine genetic differences in native species diploid populations to enhance resilience for land rehabilitation.
- Complete the determination of mechanisms of adsorption and transformation of explosives in low carbon aquifer soils for the later (applied) development of physical and biological treatment methods under these less conditions that are currently difficult to address.
- Complete determination of the basic principles of the physical and biological immobilization of 2,4- and 2,6-Dinitrotoluenes (particularly toxic explosives byproducts) in soils based upon concentration levels and soil physical and chemical characteristics.
- Complete determination of the dielectric and conductive properties of contaminated fine-grained sediments to provide the bases for the development of improved tools to characterize contaminated sites and to support the development of improved explosives treatment processes.
- Investigate other concepts by which to identify/characterize the types of micro-organisms in the ground by way of how/what they breath to aid in the development and use of biological insitu treatment processes.
- Explore the fundamental behavior of micro-organisms when introduced as part of zero-valent iron in-situ contaminant treatment systems.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601102A - Defense Research Sciences**

PROJECT  
**T25**

**FY 2002 Planned Program (Continued)**

- Determine whether explosives vapors diffuse up through frozen soil as functions of soil temperature and moisture content to support the development of improved site characterization under frozen soil conditions.
- Investigate how TNT and TNT transformation products (nitroaromatics) bind to the organic and mineral fractions of soil and determine how the nitroaromatics can be extracted from the soil fractions to support the development of improved in-situ treatment processes.
- 1252 - Establish basic understanding of physical, chemical, and biological phenomena specific to contaminant toxicity assessment and mineralization and to ecosystem maintenance, mitigation, and rehabilitation.

Total 4590

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	64854	59318	69147	0	0	0	0	0	0	0
H50 COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	9206	9671	7943	0	0	0	0	0	0	0
H53 ADV DIS INTR SIM RSCH	1467	1183	2592	0	0	0	0	0	0	0
H54 ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	9397	9868	6136	0	0	0	0	0	0	0
H56 ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	6520	5901	6072	0	0	0	0	0	0	0
H59 UNIV CENTERS OF EXCEL	9334	1970	19395	0	0	0	0	0	0	0
H62 ELECTROMECH/HYPER PHYS	8578	9860	7980	0	0	0	0	0	0	0
H64 MATERIALS CENTER	1579	2929	2174	0	0	0	0	0	0	0
H65 MICROELECTRONICS CTR	1670	1975	991	0	0	0	0	0	0	0
H73 NAT AUTO CENTER	5647	6844	2969	0	0	0	0	0	0	0
H7A SCIENCE-BASED REGULATORY COMPLIANCE STUDY	0	993	0	0	0	0	0	0	0	0
J07 COUNTER-TERRORISM PROGRAM	11456	0	0	0	0	0	0	0	0	0
J08 INSTITUTE FOR CREATIVE TECHNOLOGY	0	8124	6865	0	0	0	0	0	0	0
J09 POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	0	0	6030	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE:** This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

This program element leverages research in the private sector through Federated Laboratories, Collaborative Technology Alliances (CTA), Centers of Excellence, and the University Affiliated Research Centers. A significant portion of the work performed within this program directly supports Objective Force requirements by providing the enabling technologies which will make development of Objective Force equipment possible. Federated Laboratories are an innovative and forward thinking approach to focusing the talents of industry and academia on critical technology needs of the Army.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

They involve partnerships between the Army Research Laboratory (ARL) and industry/university consortia with recognized competencies in specific technology areas where the centers of expertise are outside of the government (i.e. telecommunications). Under the Federated Laboratory approach, ARL formed associations 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 Laboratories will complete their contracts and will be replaced by Collaborative Technology Alliances (CTAs) in late FY 2001. The CTAs will establish alliances among government, industry and academic organizations to exploit scientific and technological breakthroughs and to transition these breakthroughs to exploratory development and applied research. CTAs will be competitively established in the areas of Advanced Sensors, Advanced Decision Architecture, Communications and Networks, Power and Energy, and one applied research CTA in Robotics. This program element includes the Army's Centers of Excellence, which couple state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in materials science, electronics and rotary wing technology. The Army's Institute of Creative Technologies (ICT) is also included in this program element. The ICT is a partnership with academia and the entertainment industry to leverage innovative research and concepts for training and design. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DOD Basic Research Plan. The program element contains no duplication with any effort within the Military Departments.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	64370	54365	49026	0
Appropriated Value	65066	59865	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1730	0	0	
c. Omnibus or Other Above Threshold Reductions	-265	0	0	
d. Below Threshold Reprogramming	2222	0	0	
e. Rescissions	-429	-549	0	
Adjustments to Budget Years Since FY2001 PB	0	0	20121	
Current Budget Submit (FY 2002/2003 PB )	64864	59316	69147	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were made for a Science-Based Regulatory Compliance Study (+1000); Electromechanics and Hypervelocity Physics, Project H62 (+2000); Army (Materials) Center of Excellence, Project H64 (\$500); and the National Automotive Center (+2000).

- (+1000) Science Based Regulatory Compliance Study: The objective of this one year Congressional add is to conduct a study of and a risk assessment for chemical demilitarization activities. No additional funding is required to complete this project.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

Project without a R-2A:

Project H65

- (FY 2002 Funding = \$991) Microelectronics Center of Excellence: This program allows the Army to leverage extensive scientific manpower and knowledge of the universities to conduct innovative research and exploit new concepts in solid state physics, electrical engineering, photonics, microelectromechanical systems (MEMS) and the use of chemical/electrochemical engineering to produce microelectronic devices to support specific Army needs.

Additional funding in FY 2002 (+20000) added for the following: (1) to initiate University Affiliated Research Center focused on application of nanoscience to enhance Objective Force Warrior survivability through nanotechnology-based materials and devices (10000); (2) to create an innovative national math, science, and engineering competition for students (5000); (3) to support basic research in unmanned ground vehicle perception and intelligent control methodologies (2500); and (4) to develop fundamental principles for advanced training concepts through research under a unique Army, academia, and entertainment industry partnership (2500).



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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H50**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H50 COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	9206	9671	7943	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports a competitively selected university/industry consortium (Federated Laboratory) that was formed to provide solutions for the Army's requirements for robust, survivable, and highly mobile wireless communications networks. This Federated Laboratory completes its contract in FY2001. The project also supports a new consortium which will be competitively awarded in late FY2001, a Collaborative Technology Alliance (CTA), which links a broad range of government technology agencies and industry/academia partners with ARL. The Objective Force has a requirement for state-of-the-art wireless mobile communications networks for command-on-the-move. The barriers include designing communications systems for Survivable Wireless Mobile Networks, providing Signal Processing for Communications-on-the-Move, Secure Jam-Resistant Communications, Automated Information Protection and Detection, Survivable Information Infrastructures, and Information Assurance Situational Awareness for Mobile Tactical Information Systems. The results of this work will significantly affect Objective Force communications/networking development efforts. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 9206 - Established data distribution schemes based on adaptive triggers and intelligent agents to support a fault tolerant architecture.
- Provided 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.
- Established compression techniques for multimedia delivery to tactical networks.
- Simulated large-scale highly mobile untethered battlefield networks.
- Investigated laser communications using adaptive optics technology.

Total 9206

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**H50**

## FY 2001 Planned Program

- 9384 - Design alternative signaling protocols for call-off, origination, delivery, and internet protocol mobility in a highly mobile battlefield environment.
  - Provide a network management system based on a next-generation software-base.
  - Show 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.
  - Establish packetization and error recovery methods for multimedia communications over wireless battlefield channels.
  - Provide intermedia and interparticipant multimedia synchronization using submillisecond time synchronization to provide multimedia applications over the tactical network.
  - Establish Collaborative Technology Alliance in Communications and Networks cooperative agreement focusing on basic research into technologies to enable highly dynamic mobile tactical and sensor networks in noisy/hostile wireless environments and under severe bandwidth and energy constraints.
  - Research efforts in the areas of survivable wireless mobile networks, signal processing for communications-on-the-move, secure jam-resistant communications, and tactical information protection.
- 287 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9671

## FY 2002 Planned Program

- 7943 - Investigate and simulate dynamically self-configuring wireless network technologies including ad hoc wireless routing, medium-access-control algorithms, auto-addressing, and adaptive network configuration.
  - Investigate and simulate signal processing techniques to enable communications among highly mobile users in adverse channel conditions including channel propagation modeling, spread-spectrum and space-time coding, compression, and collision resolution algorithms.
  - Investigate and simulate secure, jam-resistant, multi-user communications effective in noisy and hostile environment including wideband low-probability of intercept signal design, adaptive spectrum reuse, interference rejection, and jammer detection and mitigation.
  - Investigate and simulate tactical information protection technologies including computationally-efficient intrusion detection, automated intrusion detection and vulnerability assessment, and highly efficient security infrastructures.

Total 7943

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

**June 2001**

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H50**

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H53**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H53      ADV DIS INTR SIM RSCH	1467	1183	2592	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports a long-term collaboration between the Army Research Laboratory and a competitively selected Army Center of Excellence in Information Sciences (ACEIS). The problem is that to date no large scale heterogeneous collaborative architectures have been modeled. Implementation and integration of future command and control system Commander/User requirements with architectures which utilize enterprise javabeen methodologies are the most significant technical barriers. Areas of emphasis include interactive and intelligent systems, database and information systems, and distributed and parallel processing systems. A major portion of the work of the ACEIS is performed at the Clark Atlanta University, a HBCU institution. Research efforts to overcome the technical barriers are listed in the FY01-03 planned program bullets below. This project also supports Army critical research at the Army High Performance Computer Research Center focused on the Objective Force, including: neutralizing the effects of airborne and groundborne contaminant transport, structural response of armored vehicles to perforating and nonperforating projectiles, investigating more efficient gun projectile and missile propulsion systems, and evaluating materials suitable for armor/anti-armor applications. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 536      - Established scenarios for experimentation and usage of a distributed information system for automating the Military Decision Making Process (MDMP).
  - Investigated the integration of intelligent whiteboard technology with a legacy (distributed combat information) system for more interactive/effective displays and interfaces.
  - Designed a data manager architecture for distributed combat information system.
  - Explored/experimented with advanced concepts for information transfer systems.
- 931      - Used computational fluid dynamics (CFD) codes and boundary layer transition prediction tools to validate and analyze recent experimental measurements to examine the aerothermal characteristics of advanced interceptor seekerheads.
  - Designed partitioning algorithms of highly unstructured and irregular graphs for efficient design of Army combat platforms for applications on both serial and parallel computers.
  - Visualized composite material manufacturing process for complex geometric structures.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H53**

**FY 2000 Accomplishments (Continued)**

- Provided efficient technologies that expedite the remediation of explosive contaminants in soils and aquifers.

Total 1467

**FY 2001 Planned Program**

- 582 - Establish a prototype data manager and distributed combat information system to capture command knowledge and experience for lessons learned repositories and after action analyses.
  - Identify, design and prototype components for C2 intelligent priority management and multimedia data management.
  - Investigate a battlefield data exchange and retrieval model based on eXtensible Mark-up Language (XML) and mobile agent technologies to enhance and speed up the MDMP.
- 566 - Apply designs of lightweight, battlefield survivable composite structures to agile platforms of the Objective Force.
  - Improve the bioavailability and biodegradability of nitroaromatic explosives within the soil granulates.
  - Examine and validate models for heated regions in the design of seekerheads for future interceptor systems.
  - Design and use different data mining algorithms to analyze scientific data sets for clustering and pattern discovery.
- 35 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1183

**FY 2002 Planned Program**

- 778 - Devise mobile agent technology for a distributed combat information systems to enhance collaboration between the Commander and his staff.
  - Design a prototype battlefield data exchange and retrieval system to automate the transfer and exchange of information between a Commander and his staff.
- 1814 - Apply intelligent processing techniques in composite manufacturing to the Objective Force.
  - Improve portability of partitioning algorithms for use in the design of Army combat platforms.
  - Analyze and apply principles of simulation based design to reduce cost and time to fielding the Objective Force.
  - Extend scalable algorithms to next generation High Performance Computing platforms.

Total 2592

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**H53**

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

June 2001

<b>BUDGET ACTIVITY</b> <b>1 - BASIC RESEARCH</b>		<b>PE NUMBER AND TITLE</b> <b>0601104A - University &amp; Industry Rsch Ctrs</b>						<b>PROJECT</b> <b>H54</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H54    ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	9397	9868	6136	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports long term collaboration between the Army Research Laboratory (ARL) and the competitively selected industry/university consortium for the purpose of leveraging world class research relevant to the needs of the Objective Force and Army Transformation needs. The current ARL Federated Laboratory explores advanced sensors and processing tools to convert raw sensor data into meaningful information for transmission over tactical networks. The technical areas addressed under this project include overcoming technical barriers associated with: multidomain smart sensors (includes multispectral infrared focal plane arrays); sensor modeling and algorithms for automatic target recognition (ATR) involving multiple sensors; radar sensors and sensing phenomenology; and signal processing. Emphasis is being placed on capitalizing on commercially available hardware, microsensors which integrate microelectromechanical systems (MEMS), acoustic, seismic, and RF technologies for application to the Objective Force materiel requirements. This Federated Laboratory comes to an end in FY2001. This project also supports a new consortium, a Collaborative Technology Alliance (CTA), which is a follow on to the Federated Laboratory, benefiting from the lessons learned from the program. The CTA will be competitively awarded in late FY2001. This CTA will link a broad range of government technology agencies and industry/academia partners with ARL. The CTA will conduct innovative research focusing on three main technical areas: microsensors, electro-optic smart sensors, and advanced frequency concepts to support the Objective Force's requirement for advanced sensing technologies. In FY2001, this project establishes a new Power and Energy CTA. Starting in FY2002, the Power and Energy CTA will be funded in 61104/J09. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 9397        - Improved atmospheric normalization of hyperspectral sensor data for remote materiel identification for enhanced target recognition and situational awareness on the battlefield.
- Reduced false alarm rate for detection of mines and buried unexploded ordnance using multi-sensor signatures.
- Evaluated networked microsensor signal processing techniques that minimize communication power for increased life of microsensors placed on the battlefield for situational awareness.
- Evaluated hybrid digital signal processing / reconfigurable computing architecture processing of acoustic data from an array of microphones.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H54**

**FY 2000 Accomplishments (Continued)**

- Designed and laboratory tested a 94 GHz radar with an 8 element single polarization electronic scanning antenna in a continuing effort to reduce the proliferation of antenna systems on the battlefield.

Total 9397

**FY 2001 Planned Program**

- 6574 - Integrate dual-band target detection algorithm into microsensor computing architecture for improved battlefield situational awareness.
- Complete moving target indicator algorithm and transition to Program Manager-Night Vision/Reconnaissance, Surveillance and Target Acquisition for application to the Long Range Advanced Scout Surveillance System.
- Evaluate network of distributed microsensors that is capable of cooperative signal processing for improved battlefield situational awareness.
- Establish capability to create dual-band Focal Plane Arrays in HgCdTe using Molecular Beam Epitaxy
- Complete 2-band Focal Plane Array for handoff to the Night Vision and Electronic Sensors Directorate of the Communications Electronics Command.
- Complete millimeter wave clutter database.
- 2000 - Establish new Sensors CTA with three main technical areas: Microsensors, Electro-Optic Smart Sensors, and Advanced Radar Frequency Concepts.
- 1000 - Establish a new Power and Energy CTA with three main technical areas: Portable Compact Power Sources (non-electrochemical), Fuel Cells and Fuel Reforming, and Hybrid Electric propulsion and Power. (Starting in FY02, the Power and Energy CTA Planned Program is funded in 61104/J09.)
- 294 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9868



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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H54**

## FY 2002 Planned Program

- 6136 - Execute first full year of new CTA with three main technical areas: microsensors, electro-optic smart sensors and advanced radar frequency concepts.
  - Investigate target and background phenomenology and modeling.
  - Investigate advanced materials and devices.
  - Investigate novel architectures and sensor fusion.
  - Investigate signal and image processing techniques and architectures.
  - Investigate automatic target recognition.

Total 6136

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H56**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H56 ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	6520	5901	6072	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports a competitively selected university/industry consortium (Federated Laboratory) that was formed to provide solutions for the many requirements for information assimilation on the battlefield. The focus of the consortium is to investigate more powerful and more user friendly computer displays and information control concepts. The problem is how to provide access to all information of practical use and provide data visualization in an efficient manner without overwhelming the user. The technical barriers associated with this project are: human-computer interface in an information rich environment; display configuration; real time visualization; architecture; information presentation; and control coupling. The approach to overcoming the technical barriers is outlined in planned program tasks for FY01-FY03. This Federated Laboratory completes its contract in FY2001. The project also supports a new consortium, a Collaborative Technology Alliance (CTA) which will be competitively awarded in late FY2001. This CTA, which will link a broad range of government technology agencies and industry/academia partners with ARL, will conduct innovative research to support the Objective Force's requirement for state-of-the-art information technology applications for responsive situational awareness, distributed commander-staff-subordinate collaboration, and planning and execution monitoring in a high tempo, high stress environment. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 5346 - Transitioned refined integrated course of action investigation and analysis tools for use in collaborative technology Science and Technology Objective (STO) and Advanced Technology Demonstrations(ATDs).
  - Published guidelines, methods and procedures for investigation of more effective visual-auditory displays and guidance on use of eye-tracking in interacting with displays.
  - Provided Beta algorithms for vision-based gesture analysis, speech/gesture integration, and bimodal speech recognition as well as selected foreign language translation (DRAGON).
  - Transitioned Automation Speech Recognition (ASR) server to collaborative technologies STO and ATDs.
  - Provided Cognitive Engineering Applications model(s) to collaborative technology STO, CECOM and Battle Labs (support output of Cognitive Engineering STO).

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H56**

## FY 2000 Accomplishments (Continued)

- 1174 - Implemented and assessed registration system and technique for overlaying 3D information onto video or see-through helmet mounted display.  
  
- Designed single and dual access electronic stabilization algorithms for mobile displays.

Total 6520

## FY 2001 Planned Program

- 5725 - Finalize refinement of the Integrated Support Laboratory (ISL) architecture and transition package to CECOM and Battle Labs.  
- Provide 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.  
- Use Army State Operator And Results-Modular Semi-Automated Forces (Soar-Mod SAF) 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.  
- Establish new cooperative agreement with Collaborative Technology Alliance in Advanced Decision Architectures.
- 176 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5901

## FY 2002 Planned Program

- 6072 - Research and identify variables in user's overall state (physical, cognitive, emotional) critical to effective and efficient use of command and control systems. Include variables that measure commander's level of trust in decision aids.  
- Investigate methods to analyze, assess certainty of, merge, and display information from diffuse sources relevant to battlefield decision-making, addressing terrain, weather, time, forces, and other factors.  
- Refine and test single and dual access electronic stabilization algorithms for mobile displays in military vehicles.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**H56**

**FY 2002 Planned Program (Continued)**

- Research cognitively valid interactive display methods that exploit different output modalities for visualizing and otherwise conveying battlespace information, uncertainty, and synchronization of spatially and temporally disparate data.

Total 6072

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H59**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H59 UNIV CENTERS OF EXCEL	9334	1970	19395	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** Army Centers of Excellence couple state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of rotorcraft scientists and engineers. The Army 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/MI. Army Centers are currently active in the fields of rotary wing technology; fuel cell technology; the foundations of image science; and science, mathematics, and engineering (SME) training. Beginning in FY2001, this project will focus on Army Rotorcraft Centers of Excellence and other technical efforts will be assigned to new projects. This project supports the Objective Force and Joint Vision 2020 by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. Industry will be encouraged to actively support Army Centers of Excellence to leverage and synergize the investment in these collaborative efforts. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2978 - Investigated and validated a first principle-based approach to model the sound wave propagation through a non-uniform, unsteady flow field.
  - Investigated wake instability, turbulence modeling, and vortex core axial velocity, using an advanced Mie-scattering technique.
  - Completed advanced design concept, such as multi-element airfoils, to reduce dynamic stall effects on maneuvering flight.
  - Established and validated analytical models for predicting response of damaged asymmetric composites under influence of hygrothermal stresses.
  - Conducted piloted simulation of transient response limit avoidance system.
  - Established an accurate elastomeric material model, including the effects on rotorcraft loads, response and stability.
- 3354 - Generated computer models of targets and synthetic image generation to guide theoretical work and verify existing image recognition theories at the Johns Hopkins University center.
  - Supported science, mathematics and engineering (SME) education at Contra Costa College to strengthen academic programs in SME and attract underrepresented minority students to careers in these fields.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H59**

**FY 2000 Accomplishments (Continued)**

- Concluded multidisciplinary research program in landmine detection and identification and transfer the results to applied research.
- 3002 - Linked entertainment industry and defense through the development of a center, the Institute for Creative Technologies, to research networked, realistic simulation tools focused on incorporating entertainment industry methods and data into combat training devices (moved to PE 0601104, Project J08 in FY2001).
  - Explored emerging entertainment technologies that may be applicable to meet future Army training needs (moved to Project J08 in FY01).
  - Researched applicability of entertainment database tools and methods for use in Army modeling and simulation (moved to Project J08 in FY2001).

Total 9334

**FY 2001 Planned Program**

- 1912 - Investigate rotor aerodynamics and acoustics during maneuvering flights.
  - Investigate passive and active noise reduction concepts for blade-vortex interactions.
  - Investigate adaptive driveshafts/struts for noise and vibration reduction, and damage mitigation.
  - Establish alleviation concepts of aeromechanical stability and whirl flutter through blade-embedded elastomeric tuned dampers for lag damping and Shape Memory Alloy (SMA)-based passive wing damping.
  - Investigate high flexibility rotorcraft driveshafts using flexible matrix composites and active bearing controls.
  - Establish simulation and controls of helicopter shipboard launch and recovery operations.
  - Investigate theory and analysis of the behavior of deformable airfoils in rotor control applications.
  - Conduct damage tolerance analysis of stiffened composites and rotor hubs.
  - Establish neural network based adaptive flight control concepts.
- 58 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1970

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H59**

**FY 2002 Planned Program**

- 1985 - Investigate vibration mechanisms and establish reduction concepts in level and maneuvering flight.
  - Investigate transmission design for robust diagnostics and prognostics.
  - Establish carefree maneuvering control laws for rotorcraft.
  - Investigate deformable wake dynamics for maneuvering flight simulation.
  - Investigate warping actuation of rotor blades by using active materials.
  - Investigate data fusion and biomimetic materials for rotorcraft health monitoring systems.
  - Establish advanced analysis, design and experimental testing capabilities of hybrid active-passive rotor systems for vibration reduction and performance enhancement.
- 9910 - Establish University Affiliated Research Center focusing on application of nanoscience to enhance Objective Force Warrior survivability through nanotechnology-based materials and devices.
- 2500 - Accelerate image science research to develop algorithms for cluttered, highly dynamic scenes to improve real-time robotic perception.
  - Investigate artificial intelligence based algorithms to enable adaptive tactical behaviors in diverse, complex environments.
- 5000 - Complete concept for Army Competition in Education and develop education testing package.
  - Conduct regional beta test of the web-based game challenge and launch Army Competition in Education Program.

Total 19395

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H62**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H62 ELECTROMECH/HYPER PHYS	8578	9860	7980	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project funds electromechanics and hypervelocity physics Army basic research relating to electromechanical components (electromagnetic launchers and power supplies) for applications to electromagnetic (EM) guns. Additionally, this project provides for research, testing and computer modeling of advanced hypervelocity projectiles. This project funds a University Affiliated Research Center, the Institute for Advanced Technology (IAT), at the University of Texas. In keeping with the Army EM Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power, materials to achieve extended rail life, and on establishing the utility of hypervelocity projectiles. The sum of these focused efforts serves as a catalyst for technological innovation and provides crucial support to the Army technology base for advanced weapon systems development with applications for anti-armor, artillery, air defense, and the Objective Force. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 8578 - Investigated pulsed power technology with emphasis on the disk topology approach.
- Investigated alternative EM pulsed power applications.
- Examined high current, fast transient switching for EM pulsed power.
- Examined launcher and launch package technologies for future field applications.
- Conducted experiments on the robust defeat capabilities of EM gun penetrators.
- Examined electric power generation, storage and distribution for mobility.

Total 8578



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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**H62**

## FY 2001 Planned Program

- 7566 - Evolve thermal management technology for EM pulsed power, switching, and railgun needs.
    - Design and implement laboratory launcher for technology evaluation and investigations of transition in the armature.
    - Evaluate alternate EM pulsed power options.
    - Evaluate material and structural components of launchers and launch packages for future field applications.
    - Exploit robust EM gun penetrators.
    - Conduct research on advanced switch technology.
  - 2000 - FY2001 Congressional add to advance state-of-the-art research in pulsed power, to achieve extended rail life and to establish the utility of hypervelocity projectiles for electromagnetic guns.
  - 294 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 9860

## FY 2002 Planned Program

- 7980 - Devise solutions for armature transition using the C-armature.
  - Evaluate laboratory launcher and launch packages for technology evaluation.
  - Conduct component trials for alternate EM pulsed power options.
  - Prove advanced material and structural components of launchers and launch packages for future field applications.
  - Prove robust EM gun penetrator lethality against advanced targets.
  - Investigate the utility for optical triggering for advanced EM switch technology.

Total 7980

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H64**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H64 MATERIALS CENTER	1579	2929	2174	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project concentrates scientific resources on research to advance innovative materials technologies and exploit breakthroughs in materials science and engineering through Materials Cooperative Research Agreements (MCRAs). MCRAs promote long-term synergistic collaboration between Army Research Laboratory (ARL), Aberdeen Proving Ground, MD, scientists and university researchers. The MCRAs provide for mutual exchange of personnel and sharing of research facilities with U. Delaware, Johns Hopkins U., U. Maryland-College Park, U. Minnesota, U. Pennsylvania, Tuskegee U. and Howard U. The MCRAs focus research on armor, anti-armor, personnel protection, ground vehicle, rotorcraft and tactical missile applications. Lightweight, multi-functional composites, advanced armor ceramics, bulk amorphous metals, nanomaterials technology, and new polymer hybrid materials for flexible extremities (combat warrior) protection are emphasized. Closely coordinated with ARL in-house materials research projects (PE 0601102A, Project H42), this effort enables the effective and efficient transfer of fundamental scientific research to address requirements for the Objective Force. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1579 - Completed models of induction-based processing of specialty composites for munitions and transitioned technology to Army tank ammunition manufacturing development program.
- Devised algorithms for computational optimization of composite processes through integration of genetic algorithms and gradient-sensitivity methods.
- Invented series of Zr-Ti-X-Ni-Al bulk amorphous metals that exhibit a dramatic increase in strain-to-failure from 1-3% to 7%.
- Determined high-strain-rate behavior of metal matrix composites with varying volume fraction of ceramic incorporations.
- Completed processing and characterization studies of elastomer/nylon microlayered composites.

Total 1579

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**H64**

## FY 2001 Planned Program

- 2342 - Devise analytical and computational models of structural response of composite armor during ballistic impact.
    - Devise models relating microstructural deformation and damage in polymer composites during dynamic loading.
    - Characterize high-strain-rate mechanical properties and damage accumulation mechanisms of metal/intermetallic microlaminates.
    - Optimize joining of high performance ceramics in metal encapsulations.
    - Devise electromagnetic manipulation strategies for controlling orientation in electrospinning of nanofibers, and assess the effects of orientation on microstructure.
  - 500 - Enhance Materials Center of Excellence research ongoing at the University of Delaware (FY2001 Congressional add).
  - 87 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 2929

## FY 2002 Planned Program

- 2174 - Devise techniques and models for controlling functionally-graded properties in thick-section composites.
    - Devise models of energy dissipation mechanisms in the composite backing plate of lightweight armors during ballistic impact.
    - Produce and characterize controlled macrostructure ceramic armor materials.
    - Devise computer techniques to model and optimize the use of graded metal matrix composites in dynamic failure environments.
    - Synthesize novel organic/inorganic hybrid materials for ultra-light weight personnel extremities protection systems.
- Total 2174

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H65**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H65 MICROELECTRONICS CTR	1670	1975	991	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This program supports a long-term collaboration between Army Research Laboratory scientists and universities. It allows the Army to leverage the extensive scientific manpower and expertise of the universities. The universities work in a collaborative manner with Army scientists to address critical technologies for the Army's Future Combat System (FCS) and Objective Force related to power and energy: batteries, fuel cells, high temperature power electronics, and novel non-electrochemical compact power generation techniques. The goals of this effort are to conduct innovative research and exploit new concepts in solid state physics, electrochemistry, electrical engineering, microelectromechanical systems (MEMS), and chemical/electrochemical engineering to support specific Army needs. The program provides for a mutual exchange of personnel and for a sharing of research capabilities.

**FY 2000 Accomplishments**

- 1670 - Showed that deposited aluminum nitride films have promise for passivation of high temperature electronics.
- Investigated new catalysts to improve methanol fuel cell efficiency.
- Optimized the fabrication process for MEMS RF filters.

Total 1670

**FY 2001 Planned Program**

- 1917 - Investigate the use of deposited aluminum nitride films for high temperature voltage controlled switched for hybrid electric drive vehicles (FCS).
- Complete SiC deep etch process to fabricate MEMS structures for compact power sources.
- Explore a method to inhibit methanol oxidation of the cathode to extend the lifetime of fuel cells.
- 58 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1975

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H65**

## FY 2002 Planned Program

- 991 - Formulate a device model for voltage controlled high power high temperature switched using new alternative dielectrics (not SiO<sub>2</sub>).
- Fabricate MEMS structures for use in compact power energy sources.
- Investigate new additives to the methanol fuel cell to extend the life and increase the electrode voltage.

Total 991

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**H73**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H73 NAT AUTO CENTER	5647	6844	2969	0	0	0	0	0	0	0

**A. Mission Description and Budget Item 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 Wisconsin, Wayne State University, University of Alaska, University of Tennessee, and Clemson University, while key industry partners include the major U.S. automotive manufacturers and suppliers. The 21st Century Truck Initiative will research alternate fuels, advanced propulsion, advanced materials, reduced parasitic losses, vehicle intelligence, and safety. In FY 2001, Congress added \$2 million for NAC university research. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2877 - Completed the mathematical formulation of the next generation of high fidelity military vehicle simulation models.  
- Completed a thorough evaluation of new simulation capabilities using enhanced, unique experimental procedures.
- 2770 - Completed the formation of high-resolution computer databases that represent real-world terrains for use in interactive vehicle simulations.  
  
- Completed a vehicle system modeling approach that is suitable for real-time simulation of on-road vehicles such as passenger cars, light trucks, and heavy trucks.

Total 5647

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**H73**

## FY 2001 Planned Program

- 2796 - Explore concepts for simulating and advancing technology in vehicle intelligence and wireless systems for future Department of Defense (DOD) and Army applications.  
- Evaluate methods for validating unique simulation environments.
- 1849 - Perform simulation based modeling and analysis in support of all areas of technology under investigation.  
- Optimize powertrains for the Army's next generation of vehicles.  
- Perform state-of-the-art trade-off analyses on concept vehicles and components.  
- Research the current state-of-the-art in advanced sensing systems for vehicle intelligence systems.
- 2000 - Congressional add will be used for the modeling of ground vehicles with simulation based acquisition in support of enhancement of simulation based acquisition tools.
- 199 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 6844

## FY 2002 Planned Program

- 2969 - Optimize the dual-need overall simulation network.  
- Continue exploring concepts for advancing technology of wireless vehicle intelligence systems for future DOD and Army applications.  
- Experimentally validate fully functional system model using advanced hardware prototypes.

Total 2969

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**J07**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
J07 COUNTER-TERRORISM PROGRAM	11456	0	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project established a one year Congressionally-directed program to be conducted by the Army Engineer Research and Development Center and a competitively selected industry/university consortium for the purpose of leveraging world class research relevant to mitigating the efforts of terrorist acts. This basic research program explored technologies that deter, resolve, and mitigate terrorist acts, including physical structure and effects research. The research investigated revolutionary approaches in science and technologies that will provide next generation solutions for force protection and terrorist threats. These technologies include new and/or improved structural strengthening methods and materials to building collapse, improved window, roof, wall systems to reduce injuries from flying glass and debris, new blast shielding systems, and vulnerability assessment modeling. The work was managed by the Structures Laboratory, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

**FY 2000 Accomplishments**

- 11456 - Completed the conceptual design of the blast load simulator to investigate debris hazard mitigation technology; awarded a contract to complete the design and to fabricate the blast load simulator.
- Awarded contracts to: Pennsylvania State University to investigate explosive load definition, precision impact tests, material behavior, structures and structural components performance and safety; Mississippi State University to investigate constitutive modeling, computational methods, simulations and code validation; and Jackson State University to investigate computational simulations, code validation, structural behavior, performance and safety, assessments, technology transfer and training.

Total 11456



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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**J07**

**FY 2001 Planned Program**

Not funded in FY 2001.

**FY 2002 Planned Program**

Not funded in FY 2002.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**J08**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
J08 INSTITUTE FOR CREATIVE TECHNOLOGY	0	8124	6865	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports simulation and training technology research at the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. The ICT was established in August 1999 by DDR&E as a University Affiliated Research Center (UARC) to support Army training and readiness through research into simulation and training technology for applications such as mission rehearsal, leadership development, and distance learning. The ICT will actively engage industry (multimedia, location-based simulation, interactive gaming) to exploit dual-use technology and will serve as a means for the military to learn about, benefit from, and facilitate the transfer of applicable entertainment technologies into military systems. The ICT will also work with creative talent from the entertainment industry in order to adapt their concepts of story and character to increasing the degree of participant immersion in synthetic environments and to improve the realism and usefulness of these experiences. In return, industry will leverage DoD-sponsored research being done by the Modeling and Simulation UARC. Creating a true synthesis of the creativity, technology and capabilities of the industry and the R&D community will revolutionize military training and mission rehearsal by making it more effective in terms of cost, time, the types of experiences that can be trained or rehearsed, and the quality of the result. It will also allow the United States to maintain dominance in simulation and training technologies. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- FY 2000 project work was supported by Project H59.

**FY 2001 Planned Program**

- 7882 - Examine entertainment industry methods and data for their applicability to networked, realistic simulation tools for combat training.
- Conduct research to understand the levels of reality/fidelity required to suspend disbelief and generate verisimilitude in virtual environments in support of the new Army Vision/Transformation.
- Investigate the use of avatars to depict locals, friendly and hostile forces and mission team members for mission rehearsal environments.

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

June 2001

BUDGET ACTIVITY

**1 - BASIC RESEARCH**

PE NUMBER AND TITLE

**0601104A - University & Industry Rsch Ctrs**

PROJECT

**J08**

## FY 2001 Planned Program (Continued)

- Create advanced immersive environment utilizing sound, visual cues, motion and other sensory elements.

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

Total 8124

## FY 2002 Planned Program

- 4365 - Conduct basic research in the three essential elements of immersive environments - graphics visualization, immersive 3D audio environments and algorithms, and virtual humans including non-verbal communication (e.g. gesture, gaze, emotion, facial expression).  
- Conduct research to exploit advances in computer science to explore techniques, algorithms, methods, and multi-sensory stimuli to enhance training across operational military functions.
- 2500 - Accelerate research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness.

Total 6865

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**J09**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
J09 POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	0	0	6030	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project establishes a Collaborative Technology Alliance (CTA) in Power and Energy Technologies. The CTA will form a long-term collaboration between the Army Research Laboratory (ARL) and a competitively selected industry/university consortium for the purpose of leveraging world-class research relevant to Army needs. Power and energy research supporting lightweight, compact power for the individual soldier and fuel efficient vehicles and robotic platforms will be conducted. Technical barriers include overcoming energy density limitations of traditional electrochemical portable power sources, reforming of logistics fuels to generate hydrogen, and reducing the size and weight of hybrid electric propulsion components and systems. This project is being competitively bid in FY2000/FY2001 with an award in FY2001. In FY2001 this program is funded in 61104/H54. The CTA will focus on three main technical areas: Portable Compact Power Sources (non-electrochemical), Fuel Cells and Fuel Reforming, and Hybrid Electric Propulsion and Power. These technologies are fundamental elements required to realize the Army Transformation and support the Objective Force. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- None.

**FY 2001 Planned Program**

- None. FY2001 program is funded in 61104/H54.

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

June 2001

BUDGET ACTIVITY  
**1 - BASIC RESEARCH**

PE NUMBER AND TITLE  
**0601104A - University & Industry Rsch Ctrs**

PROJECT  
**J09**

## FY 2002 Planned Program

- 6030 - Execute first full fiscal year of new CTA with three main technical areas: Portable Compact Power Sources (non-electrochemical), Fuel Cells and Fuel Reforming, and Hybrid Electric Propulsion and Power. (Specific milestones/deliverables will be determined after program is competitively awarded in FY01).
    - Establish and adapt specific milestones/deliverables for the Cooperative Agreement after the competitive award is made.
- Total 6030

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602105A - Materials Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	15077	27326	13794	0	0	0	0	0	0	0
H7B ADVANCED MATERIALS PROCESSING	0	6951	0	0	0	0	0	0	0	0
H7C AMORPHOUS METAL KINETIC ENERGY PENETRATOR	0	2979	0	0	0	0	0	0	0	0
H84 MATERIALS	12691	11451	13794	0	0	0	0	0	0	0
HM1 HARDENED MATERIALS	2386	5945	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

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. It provides the technologies essential for Army Transformation. Project AH84 is directed toward devising materials technology that will make our heavy forces lighter and more deployable, and our light forces more lethal and survivable. It provides the technology base required for solving materials-related problems in individual soldier support equipment, armor, armaments, aircraft, ground and combat vehicles and combat support. Technology for advanced materials will enable the Future Combat Systems' (FCS) and Objective Force survivability and lethality. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602105A - Materials Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
President's Previous Budget (FY 2001 PB)	16266	11557	14385	0
Appropriated Value	16349	27557	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-189	0	0	
c. Omnibus or Other Above Threshold Reductions	-29	0	0	
d. Below Threshold Reprogramming	-1000	0	0	
e. Rescissions	-54	-253	0	
Adjustments to Budget Years Since FY2001 PB	0	0	-591	
Current Budget Submit (FY 2002/2003 PB )	15077	27304	13794	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for HM1, Composite Materials Technology (+6000); Amorphous Kinetic Energy Penetrator Materials Technology (+3000); and Advanced Materials Processing Technology (+7000).

-(+6000) Composite Materials Technology to focus on advanced resins and fibers, thick-section mechanics, damage tolerance, processing sciences, validated design models, and predictive models for the optimal application of composite materials for FCS requirements.

-(+3000) Amorphous Kinetic Energy Penetrator Materials Technology focuses on discovery and synthesis of a high-density, low cost, bulk amorphous

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602105A - Materials Technology**

metal alloy for use in developing composite materials as alternatives to depleted uranium for kinetic energy penetrators.

- (+7000) Advanced Materials Processing Technology focuses on the development of a unique multi-axis friction stir capability/technology to achieve stronger welds in lightweight materials for application to Objective Force combat platforms.

FY 2003: Funds realigned (-2103) to higher priority programs.



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602105A - Materials Technology**

PROJECT  
**H84**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H84 MATERIALS	12691	11451	13794	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The goal of this project is to provide the technical foundation for materials technology in metals, ceramics, polymers, and composites that are essential for lethal and survivable Future Combat Systems (FCS) and other Objective Force platforms. In order to meet the challenge of the Army Vision, new systems must be significantly lighter, more deployable, and more sustainable. The barrier to this challenge is the requirement for new materials and structures solutions that offer significant weight reduction with improved performance, durability and cost reduction for application to individual soldier support equipment, armor, armaments, aircraft, ground combat vehicles, and combat support equipment. This project will address these needs through: improved physics-based material, mechanics, and structural models; high strain rate material characterization techniques; non-destructive inspection/evaluation technologies; new high strength/temperature materials and coatings; and advanced fabrication/processing methodologies. Applied research efforts are focused in armor/armament materials, as well as lightweight structural materials and materials affording protection against chemical, biological, or directed energy threats. The work is conducted at the Army Research Laboratory, 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 and Missile Research, Development and Engineering Center, Huntsville, AL; the Natick Soldier Center, Natick, MA; the Edgewood Chemical and Biological Center, Edgewood, MD; and the Communications and Electronics Research Development and Engineering Center, Ft. Monmouth, NJ. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 8099 - Devised 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.
- Quantified and optimized sensor arrays to assess ballistic damage, environmental degradation and potential chemical/biological agent threats.
- Devised and evaluated new mass-efficient means to improve the ballistic resistance of ceramics by integrating them with organic-matrix composites to enable improved lightweight combat vehicles.
- Determined the microstructural influences of metallic-intermetallic-ceramic components on the performance of current composite armor designs.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602105A - Materials Technology**

PROJECT  
**H84**

**FY 2000 Accomplishments (Continued)**

- Determined high strain-rate behavior and failure criteria of layered and functionally graded ceramics, metals and anisotropic composites to develop constitutive models for the rational design of materials for high-performance, integrated, multifunctional armors.
- 2800 - Devised atomic scale, physics-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.  
 - Determined dielectric materials for antenna sections that will enable extended range and improved accuracy for both direct and indirect fire weaponry.
- Devised refractory metal explosively formed projectile liners and determined their processibility.
- 1085 - Determined critical materials technologies essential for the successful testing of pulsed power machines for the Objective Force.
- 707 - Conducted microwave Non-Destructive Evaluation (NDE) measurement and analyses for large composite structures; devised more portable and field usable laser ultrasonic inspection technique; and evaluated an advanced off-road, high-speed wheeled testbed, for structural dynamics research.

Total 12691

**FY 2001 Planned Program**

- 7069 - Evaluate reduced-cost, appropriate quality processing technology for lightweight combat vehicles that feature integrated armor structure technologies.  
 - Devise structure/property relationships, processing methodologies, and advanced characterization techniques for emerging nanomaterials and multi-functional protective coatings to enable a survivable and sustainable Objective Force.  
 - Model and engineer emerging lightweight armor materials and structures to improve penetration resistance and minimize collateral damage in future lightweight combat vehicles.  
 - Devise physics-based models and perform ballistic evaluation to characterize the failure mechanisms of personnel protective armor materials to ballistic impact of emerging threats.
- 3590 - Optimize physics-based models of propellant interactions with gun bore surface and transition thermo-chemical erosion modeling package to armament developers for design of improved wear-resistant gun tubes  
 - Evaluate thin film phase shifter materials with properties comparable to bulk materials to significantly reduce the cost and weight of future antenna systems

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602105A - Materials Technology**

PROJECT

**H84****FY 2001 Planned Program (Continued)**

- Validate mechanical/thermal models and characterize mechanical/thermal fatigue properties of continuous fiber metal matrix composites (MMC) for application to future lightweight munitions and gun tubes.

- 741 - Evaluate active control technologies for advanced high-speed, off-road, ground vehicles; devise advanced laser ultrasonics, microwave, and thermal NDE technologies for thick multi-layered structures in support of FCS; investigate sensor technologies to assess fatigue behavior in metallic and composite structures; and experimentally characterize high-speed, ground vehicle tire and TACOM 5-ton truck tire to provide modeling and simulation input parameters.
- 51 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 11451

**FY 2002 Planned Program**

- 7483 - Provide improved process for affordably and reliably infusing composite and multi-functional materials to produce low cost, large-scale sections for FCS and Objective Force platforms.
  - Design and synthesize novel nano-structured materials and multi-functional coatings to provide improved protection and sustainability for the Objective Force.
  - Validate penetration and structural simulations and integrate emerging materials technology (lightweight metals, ceramics, ceramic laminates, composites, and energetic materials) with novel defeat mechanisms for FCS armors and survivability concepts.
  - Investigate novel lightweight armor materials and processing techniques and refine physics-based models to improve the performance of ballistic protection for the future lightweight warrior.
- 3490 - Devise improved models, characterization techniques, and processing technologies to enable the design and synthesis of improved penetrator/warhead materials for future munitions.
  - Evaluate electro-ceramic materials for discrete and integrated microwave applications including fire control radar, smart munitions, and point-to-point communications.
  - Optimize mechanical characterization techniques, modeling and simulation design tools, and processing capability for continuous fiber MMCs for FCS armament/ammunition applications.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602105A - Materials Technology**

PROJECT  
**H84**

## FY 2002 Planned Program (Continued)

- 821 - Evaluate a prototype laser ultrasonic NDE concept that uses low energy, low cost pulsed laser diodes for improved detection; establish database of microwave measurements to improve damage assessment in Army composite structures; extend fatigue sensor to enhance measurement of fatigue life expended in ground vehicle dynamic components; and investigate alternative control algorithms for a Fuzzy Logic Controller for an active vehicle suspension to enhance performance and response.
- 2000 - Explore novel methodologies for the integration of nanomaterials technologies, and emerging concepts from the Institute for Soldier Nanotechnologies University Affiliated Research Center, to enable the design and development of future ultralightweight, multifunctional personnel protective system(s) for the Objective Force Warrior.

Total 13794

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602120A - Sensors & Electronic Survivability**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	22978	23008	25797	0	0	0	0	0	0	0
140 HI-POWER MICROWAVE TEC	2465	2687	2771	0	0	0	0	0	0	0
142 PASSIVE MMW CAMERA	1909	2477	0	0	0	0	0	0	0	0
H15 GROUND COMBAT ID TECH	3245	3441	8069	0	0	0	0	0	0	0
H16 S3I TECHNOLOGY	15359	14403	14957	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The objective of this program is to enhance the capabilities of the Future Combat Systems (FCS) and the Objective Force by: (1) providing sensor, signal and information processing technology for advanced reconnaissance, surveillance, and target acquisition (RSTA), ground-to-ground and air-to-ground combat identification (ID), and fire control systems, as well as the fuzing and guidance-integrated fuzing functions in future munitions; and (2) significantly improving the survivability, lethality, deployability, and sustainability of FCS by devising high-power electronic components and technologies for compact, light-weight power and energy storage, conversion and conditioning, and radio frequency (RF)/microwave directed energy (RF-DE) weapons. Critical technologies to be addressed to increase the combat effectiveness of tactical Army forces include: (1) high power, solid-state/vacuum, power/RF component 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)

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602120A - Sensors & Electronic Survivability**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	24850	20722	21994	0
Appropriated Value	24978	23222	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-372	0	0	
c. Omnibus or Other Above Threshold Reductions	-57	0	0	
d. Below Threshold Reprogramming	-1500	0	0	
e. Rescissions	-71	-214	0	
Adjustments to Budget Years Since FY2001 PB	0	0	3803	
Current Budget Submit (FY 2002/2003 PB )	22978	23008	25797	0

Change Summary Explanation: Funding - FY 2001: A Congressional add was received for Project 142, Passive Millimeter Wave (MMW) Camera (+2500) to complete the fabrication and perform field testing of a new and improved version of the camera that will be lightweight, low-cost, and flightworthy. FY 2002: Increase made in support of the Coalition Combat Identification Advanced Concepts Technology Demonstration (+3803).

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602120A - Sensors &amp; Electronic Survivability</b>				PROJECT <b>140</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
140      HI-POWER MICROWAVE TEC	2465	2687	2771	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to significantly improve the survivability, lethality, deployability, and sustainability of Future Combat Systems (FCS) and the Army's Objective Force by devising high-power electronic components and technologies for compact, lightweight power and energy storage, conversion and conditioning. Current technical barriers result in excessive size and weight requirements for these components and systems. Matching potential FCS radio frequency (RF)/microwave directed energy (RF-DE) and high energy laser (HEL) weapons and other electric power loads such as electromagnetic gun, electromagnetic (EM) armor and electric drive to the FCS electric power sources will be improved with the advances in this project. This program is coordinated and, when appropriate, leveraged with directed energy (both RF and laser) and power programs in the Air Force, Navy, Defense Special Weapons Agency, National Labs, university Consortia and relevant industry and foreign partners. The emphasis of this project is being focused to more effectively support the Army Transformation, by concentrating on the critical path technology of power components common to all Directed Energy Weapons (DEW) and hybrid electric propulsion systems. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2465      - Constructed and operated a 3-phase to 3-phase, 20-kW class matrix converter prototype suitable for application in future electric combat vehicles.
  
- Designed initial requirements with TACOM-ARDEC for RF Agile Target Effects System (ATES) for the Battlefield.
- Provided expertise on Directed Energy Weapon (DEW) threats, effects and hardening to National Intelligence Council, Defense Threat Reduction Agency, Army Research Development and Engineering Centers, Program Managers, and TRADOC.
- Conducted source/antenna technology survey to address ATES requirements and investigated compact, high power antenna concepts for the FCS.
  
- Evaluated alternatives for RF- DEW components/systems for lethal/non-lethal applications for FCS.
- Transformed the research focus on this project to high power component technology to enable hybrid electric propulsion development supporting Army Transformation.

Total    2465

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602120A - Sensors & Electronic Survivability**

PROJECT

**140**

## FY 2001 Planned Program

- 2655 - Show the value of the matrix converter concept to the Army's FCS program by operating a 10-kW class matrix converter in a relevant environment.
  - Achieve initial laboratory operation of a 3-phase to 3-phase 100-kW class matrix converter prototype.
  - Research power conditioning topologies (modulators) for FCS applications, such as EM armor and DEWs.
  - Evaluate advanced energy storage techniques, such as modeling the Marx-Generator configured, lithium-ion battery system.
  - Conduct research into new DEW components/system and perform initial system design for RF-ATES breadboard.
  - Model electro-mechanical behavior of advanced power sources, such as the linear alternator to enable hybrid power system design and optimization.

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

Total 2687

## FY 2002 Planned Program

- 2771 - Operate the 100-kW matrix converter in a laboratory breadboard environment.
  - Evaluate alternatives for solid-state switch-based power conditioning topologies for EM armor.
  - Evaluate advanced energy storage techniques - construct Marx-battery breadboard.
  - Investigate effectiveness of DEW candidates for ATES and finalize requirements.
  - Model electro-mechanical to combustion linear alternator with diesel engine driver to enable hybrid power system design and optimization.

Total 2771



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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602120A - Sensors &amp; Electronic Survivability</b>				PROJECT <b>142</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
142 PASSIVE MMW CAMERA	1909	2477	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This is a Congressionally funded program; not part of the Army's core mission. This is a development technology program for a passive/active MMW imaging system to demonstrate its performance capabilities as a covert all-weather surveillance and target acquisition system. Funding is provided to perform research on enabling MMW technologies in support of passive/active MMW imaging. These funds have been provided to the Army Research Lab as a result of Congressional interest for the development of a Passive MMW Camera (PMC).

**FY 2000 Accomplishments**

- 1909 - Investigated components and the design for a Passive Millimeter Wave Camera (PMC) with improved thermal resolution, wider field of view, true video frame rate, and a fully filled antenna aperture.
- Total 1909

**FY 2001 Planned Program**

- 2404 - Complete the fabrication and perform field testing of the new and improved version of the PMC that will be lightweight, low-cost, and flightworthy for radio-silent navigation and landing, reconnaissance, and search and rescue under conditions of clouds and fog.
  - 73 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 2477

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602120A - Sensors & Electronic Survivability**

PROJECT

**142**

**FY 2002 Planned Program**

- Program not funded in FY02.

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602120A - Sensors &amp; Electronic Survivability</b>						<b>PROJECT</b> <b>H15</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H15 GROUND COMBAT ID TECH	3245	3441	8069	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective is to develop and demonstrate emergent combat identification (CID) systems for air-to-ground and ground-to-ground (mounted, dismounted, forward observer and forward air controller) mission areas for the objective force in support of Joint, Allied and Coalition operations (i.e. US, UK, France, Germany, Canada, Australia, and Kuwait). This program provides the technologies necessary for the Coalition Combat Identification Advanced Concept Technology Demonstration. The program provides maturation of the enabling technologies necessary to set the baseline for the objective force to enable fratricide reductions through Combat Identification (CI) concepts for Joint, Allied and Coalition operations. The hardware and software improvements and modeling and simulation (M&S) advances provided by this program are essential for linkage to the Objective Force as we progress to the transformation of the Army. This program expands and builds upon the increased lethality for the Objective Force due to greater capability to identify friend from foe and minimize fratricide incidents across the battlefield. CI must be software functional, portable across a family of platforms, tied to the future tactical internet, over-the-horizon capable and highly resistant to countermeasures. The Objective Force CI capability will fuse situational awareness (SA) and Point-of-Engagement target Identification into a common through sight picture. The future CI architecture will necessitate the integration of a network composed of diverse reconnaissance, surveillance and target acquisition (RSTA) sensors that include non-cooperative capabilities in the sensor suites and a cooperative ID capability that will be realized as part of the future real-time SA. Coordination will be accomplished with other services, allies and coalition partners. MANPRINT will be addressed in all activities. Future CI will operate with the Objective Warrior System providing a seamless boundary with vehicle CI. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), The Army Modernization Plan, and Project Reliance. The program element contains no duplication with any efforts within the Military Departments. Work is performed by various contractors and the Communications Electronics Command (CECOM). This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP). PM Combat ID manages the FY99 to FY01 program. In FY 02 it will be transitioned to CECOM I2WD in support of the Coalition Combat ID ACTD.

**FY 2000 Accomplishments**

- 3245 - Evaluated high-fidelity technical and operational performance of Ground Integrated Target Identification System (GITIS) algorithms and simulators for baseline Combat ID for the Future Combat Systems.
- Conducted, with user participation, technical field and operational trials of the Radio Based Combat ID (RBCI) Fire Support Team (FIST) at the All Service Combat Identification Evaluation Team (ASCIET) 00.
- Investigated CI solution for Objective Force helicopters.
- Studied CI Architecture to investigate emerging technologies.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602120A - Sensors & Electronic Survivability**

PROJECT  
**H15**

## FY 2000 Accomplishments (Continued)

- Conducted RBCI study and analyzed results to migrate to Advanced System Improvement Program (ASIP) radio.
- Evaluated a lightweight CI transponder system for helicopters.

Total 3245

## FY 2001 Planned Program

- 3345
  - Characterize GITIS technical and operational performance.
  - Complete investigation of CI solution for helicopters and execute the design.
  - Complete CI Architecture Study to determine and define emerging technologies.
  - Complete evaluation of lightweight CI transponder system for helicopters.
  - Evaluate low cost, high efficiency antenna.
  - Characterize technical performance of CI for Apache-Longbow.
  - Study CI solution for vehicle-to-soldier application.
  - Implement North Atlantic Treaty Organization (NATO) Battlefield Target ID (BTID) Waveform per Standardization Agreement (STANAG) 4579.
  - Determine RBCI feasibility for Allied radios.
- 96 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3441

## FY 2002 Planned Program

- 8069
  - Implement advanced CI concepts for airborne applications for the Objective Force.
  - Evaluate several software gateways to establish a coalition SA Network.
  - Continue implementation of STANAG 4579 waveform.
  - Conduct Radio Frequency (RF) Tags study for objective force applicability.
  - Support development of STANAG for individual soldier application.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602120A - Sensors & Electronic Survivability**

PROJECT

**H15**

**FY 2002 Planned Program (Continued)**

- Perform virtual model development for experiments of all systems participating in CCID ACTD to include Objective Force applicability.

Total 8069

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602120A - Sensors &amp; Electronic Survivability</b>					PROJECT <b>H16</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H16 S3I TECHNOLOGY	15359	14403	14957	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project is focused on advanced sensor, signal processing and information technologies to provide the Future Combat Systems (FCS) and the Objective Force with decisive new capabilities to locate, identify, and engage battlefield targets. The ultimate utility of this work will be to protect our soldiers and to increase their lethality and range and speed of engagement. Emphasis is placed on solving critical Army-specific battlefield sensing and information management problems such as dealing with false target situations, complex terrain, movement of sensors on military vehicles, etc. Cost reduction is a key concern. Care is taken to insure that this work is coordinated with outside organizations, particularly the RDEC's and DARPA. Significant areas of research include the following: (1) Low cost sensors designed to be employed in large numbers as unattended ground sensors or sensors for smart munitions. Research into acoustic, seismic, magnetic, and radar sensors is being conducted. Technical barriers include low-power sensors and electronics, small-long-life batteries, autonomous reconfigurable networks, and sensor fusion to maximize the performance of a collection of relatively low performance sensors. (2) Low cost acoustic sensors that can passively detect and track battlefield targets such as tanks, helicopters, etc. and detect and locate gun fire. Technical barriers include algorithms to handle multi-path and reduce false alarm rates. Work to monitor the health of soldiers is also being explored. (3) Sensors and supporting technologies for smart munitions using GPS for guidance or tracking. Technical barriers include high-g electronics. (4) High performance multi-function radio frequency (RF) systems which allow target acquisition, combat identification, active protection, surveillance, and communications systems to consolidated into a single system, reducing system cost and size. Technical barriers include maintaining performance of each function in the combined system. (5) High performance passive and active RF sensors capable of high resolution imaging to detect targets hidden in foliage, smoke and fog. Ultra wideband radar work will enable buried mine detection and target imaging through dense foliage. Technical barriers include real-time signal processing and false alarm rate. (6) Aided/automatic target recognition (ATR) to allow sensors to autonomously or semi-autonomously locate and identify battlefield targets. This research will minimize the workload on the soldier while in combat to find and identify targets using laser radar (ladar), multi-band infrared cameras, and hyperspectral imagers. Technical barriers include acquisition of large data sets to train and validate ATR algorithms. (7) Optoelectronic (OE) interconnects and processors are being built which will greatly speed the movement of information within and between electronic digital processing units to facilitate smart sensors, adaptive sensors, and sensor fusion for situation awareness, survivability, and lethality. Sensor processing, analysis, and displays will provide soldiers with clearer, higher resolution images from their targeting systems. (8) Advanced battlefield sensor and information processing to conduct a dynamic and real time situation assessment to present a common picture of the battlespace to commanders. Technical barriers include fusion of data from dissimilar sensors, coherent display of complex information, and human factors. (9) Advanced information processing methods to provide automatic information technologies to enable commanders to utilize widely dispersed sensor and legacy information sources. Technical barriers include development of autonomous reconfigurable networks. This work supports the following Army Programs: Future Combat Systems (FCS), Objective Force, Multi-Function Starting Sensors Suite (MFS3), Warrior Extended Battlespace Sensors (WEBS), Smart Sensor Webs, Anti-Personnel Landmine Alternatives (APL-A), Precision Guided Mortar Munition (PGMM), Third

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602120A - Sensors & Electronic Survivability**

PROJECT

**H16**

Generation forward-looking infrared (FLIR), Full Spectrum Active Protection, and Quicklook. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

## FY 2000 Accomplishments

- 3812 - Created a fully polarimetric, monopulse 35GHz radar and a fully polarimetric 95GHz radiometer. Calibration techniques were used for MMW target and clutter phenomenology to improve our ability to distinguish targets from clutter.
  - Evaluated forward-looking radar imaging techniques for vehicle mounted sensors for FCS robotic vehicle applications.
  - Designed radar for tracking of kinetic energy penetrators for active protection systems (APS) for FCS.
- 1974 - Investigated and devised visible imaging microsensor and IR imaging microsensor designs for WEBS with CECOM's Night Vision and Electronic Sensors Directorate (NVESD).
  - Evaluated magnetic sensor capabilities for unattended ground sensors and determined unique areas for further research.
- 4001 - Investigated and devised advanced acoustic target identification algorithms.
  - Showed improved multi- target acoustic tracking for WEBS and MFS3.
  - Investigated a fused 3-5 micron and 8-12 micron ATR algorithm exploiting unique characteristics of each and delivered completed algorithm as part of STO IV.J.12.
- 2787 - Conducted characterization of optoelectronic image transfer over parallel vertical-cavity surface-emitting (VCSEL) laser array and free-space optical interconnect to standard complementary metal-oxide semiconductor (CMOS) electronics.
  - Replaced electronic interconnects with VCSEL/CMOS interconnects in design of AMCOM missile processor architecture.
  - Surveyed visible and IR hyperspectral data and its applicability to land warfare missions, and experimented with several algorithmic techniques to exploit this data.
  - Built and proved out extended depth of field camera system.
  - Built hybrid thick film electroluminescence structures.
  - Designed optical limiter prototypes that emulate real military optical system designs.
- 2085 - Researched a software infrastructure for the control, processing, and visualization of unattended ground sensors at Aberdeen Proving Ground, MD.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602120A - Sensors & Electronic Survivability**

PROJECT  
**H16**

**FY 2000 Accomplishments (Continued)**

- Showed the integration of gesture and natural language multi-modal interface in a 2D / 3D environment during the Army Research Laboratory Federated Laboratory conference.
- Integrated robust speech, natural language, and un-tethered gesture recognition research into multi-modal computer interface modules.

- 700 - Next- Generation Autonomous Vehicle Navigation Control System (AUTOVAV) (Partner: Germany): Design an advanced autonomous vehicle navigation control system. Conducted sub-system tests of obstacle detection, classification, and avoidance technologies.

Total 15359

**FY 2001 Planned Program**

- 3006 - Deliver and evaluate first generation reconfigurable signal processor for unattended ground sensor applications.
  - Conduct field experiment with CECOM-NVESD on acoustic, seismic, magnetic, infrared imager nodes.
  - Evaluate sensor fusion options for unattended ground sensors.
- 1176 - Show distributed networked acoustic sensors in support of STO.
  - Research and evaluate optimized physiological monitoring sensors with remote wireless capability in select operating environments.
- 735 - Generate concepts for ammunition suite for FCS program and report to ARDEC.
  - Provide GPS targeting expertise and support to ARDEC Quicklook program.
- 2434 - Evolve RF forward imaging concepts consistent with narrow aperture achievable from a ground vehicle to facilitate mobility of robotic vehicles.
  - Refine electromagnetic models and use to compute backscatter signatures of one or more tactical vehicles at VHF and UHF frequencies.
  - Compare performance and computational-load of clutter adaptive stationary target detection approaches.
  - Collect fully polarimetric target and clutter signatures with passive millimeter-wave (MMW) radiometer.
  - Achieve real-time, high precision tracking of kinetic energy penetrator in range and velocity.
- 1308 - Build and prove out a low cost vertically scanned 35 GHz antenna array element.
  - Complete control and calibration software for vertical electronically scanned (E-Scan) antenna.



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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602120A - Sensors & Electronic Survivability**

PROJECT

**H16**

## FY 2001 Planned Program (Continued)

- 977 - Conduct phenomenological studies of hyperspectral data to assess the minimum number of bands to achieve high discrimination performance at an affordable cost for land warfare systems. In parallel, investigate algorithms that can perform simultaneous compression and detection on hyperspectral data, to reduce bandwidth requirements.
  - Recommend preferred operating wavelengths for broadband imagers, based on experiments using measured phenomena. Deliver preliminary algorithms for processing such data.
  - Conduct studies with stabilization and moving-target indicator (MTI) algorithms using relevant data. Deliver preliminary codes to AMCOM.
- 2113 - Incorporate improved high-data-rate VCSEL/CMOS link into real time optoelectronic transfer of image frames with some CMOS image processing included.
  - Conduct joint measurements with AMCOM of improved VCSEL/CMOS processor in missile processor architecture.
  - Achieve full color electroluminescent devices using single host
  - Characterize engineered limiter materials in best optical designs
- 1996 - Utilize an agent based approach for mediation with legacy software subsystems to improve the Commander's ability to synchronize manned and unmanned sensor assets in a lightweight FCS force.
- 513 - Next- Generation Autonomous Vehicle Navigation Control System (AUTOVAV) (Partner: Germany): Design of an advanced autonomous vehicle navigation control system. Complete sub-system tests of obstacle detection, classification, and avoidance technologies.
- 145 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 14403

## FY 2002 Planned Program

- 3190 - Complete and evaluate second generation reconfigurable processor for unattended ground sensors.
  - Evaluate multi-sensor nodes systems against real targets along with CECOM-NVESD and transition all WEBS technologies to follow-on advanced technology demonstration (ATD).
- 1309 - Study performance of three-axis seismic sensors for direction finding and fuse data output with acoustic sensors.
  - Implement efficient algorithms for target recognition for WEBS low power unattended ground sensor application.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602120A - Sensors & Electronic Survivability**

PROJECT  
**H16**

**FY 2002 Planned Program (Continued)**

- Prove out high-resolution beam forming algorithms for long-range infrasonic detection.
- 450 - Evaluate concepts for ammunition suite for FCS program and report to ARDEC.
- 2886 - Complete RF forward imaging experiments for robotic vehicle sensors and generate synthetic aperture radar (SAR) images from measured data.
- Generate improved tactical target detection algorithm and brief results to DARPA and foliage-penetrating (FOPEN) radar prime contractor.
- Recommend an adaptive stationary target detection approach for real aperture radars.
- Model polarimetric target and clutter signatures for passive and active MMW sensors.
- Integrate radar with IR angle tracker and demonstrate real-time engagement of KE penetrator.
- Explore innovative concepts in long-wavelength and high-bandwidth VCSELs for VCSEL/CMOS interconnects and processing.
- 1319 - Complete building of multi-function RF testbed.
- Generate real-time timing and control hardware and software to implement communications and radar functions.
- 825 - Investigate improvement in material classification/target identification algorithms through the use of adaptable hyperspectral algorithms that adjust to environmental variation in signatures.
- Conduct feature studies of 3-5 micron and 8-12 micron imagery to determine efficacy of dual band features.
- Investigate registration techniques, image differencing, and change detection strategies for target acquisition.
- 2775 - Apply VCSEL/CMOS links to unorthodox digital processing architectures for improved processing of images and other sensor data.
- Build displays on flexible substrates.
- 2203 - Integrate software components from Advanced Battlefield Processing Technology STO to improve information access and operator focus of attention, enabling the warfighter to operate within the enemy's decision cycle.
- Significantly improve tactical knowledge management through intelligent agent based applications and information portals; intelligent systems will acquire and reason on data related to terrain, weather, force distribution, etc. from local and reach back sensors and sources presenting the information from these disparate sources without distorting the spatial and temporal properties of the information.

Total 14957

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	29213	30794	49265	0	0	0	0	0	0	0
47A AERON & ACFT WPNS TECH	25967	27249	45584	0	0	0	0	0	0	0
47B VEH PROP & STRUCT TECH	3246	3545	3681	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The Aviation Technology program element (PE) conducts applied research and expands scientific knowledge in the area of rotary wing vehicle (RWV) technologies for transition to advanced development technology validations. The intent is to support authentication of new and / or upgraded Army / DoD rotorcraft systems for the Objective Force and Joint Vision 2020 to improve tactical mobility, reduce logistics footprint, focus combat power, and increase survivability for RWVs. The Army Aviation Science and Technology programs 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 unmanned aerial vehicles (UAV) rotorcraft, aeromechanics, aerodynamics, flight control, aeroacoustics, structures, propulsion, reliability and maintainability, safety and survivability, mission support equipment, aircraft system synthesis, comprehensive rotorcraft analysis, flight simulation, aircrew-aircraft integration, avionics and aircraft weapons integration. The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, 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 maturing of rotorcraft science and technology), 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 matched by industry. Army, NASA, Navy, and Federal Aviation Administration (FAA) provide staffing and support of the NRTC operations. Efforts under this PE transition to projects supported by PE 0603003A (Aviation - Advanced Technology). Technology matured in this PE supports current and future rotorcraft for the Objective Force. Upgrade activities of Army systems such as the AH-64 Apache, RAH-66 Comanche, UH-60 Black Hawk, Navy SH-60 Seahawk and USMC AH-1 Cobra are included 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 Aircraft Engines, Lynn, MA; Honeywell, Phoenix, AZ; Sikorsky Aircraft Corporation, Stratford, CT; Rolls-Royce/Allison, Indianapolis, IN; Kaman Aerospace Corp., Bloomfield, CT; Pratt & Whitney, Hartford, CT; Raytheon Company, Arlington, VA; 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, UT; Virginia Polytechnic Institute and State University, VA; Wichita State University, KS; Cornell

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

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. The program element contains no duplication with any effort within the Military Departments. Work is led by the Aviation and Missile Command and Army Research Laboratory through the Army Materiel Command

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	30048	31080	31475	0
Appropriated Value	30165	31080	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-416	0	0	
c. Omnibus or Other Above Threshold Reductions	-64	0	0	
d. Below Threshold Reprogramming	-419	0	0	
e. Rescissions	-53	-286	0	
Adjustments to Budget Years Since FY2001 PB	0	0	17790	
Current Budget Submit (FY 2002/2003 PB )	29213	30794	49265	0

Change Summary Explanation: Funding - FY 2002 funding was increased to demonstrate a long endurance, armed, unmanned rotary wing platform for the Objective Force (+17735).

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>			PE NUMBER AND TITLE <b>0602211A - Aviation Technology</b>						PROJECT <b>47A</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
47A AERON & ACFT WPNS TECH	25967	27249	45584	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Aeronautical and Aircraft Weapons Technology project matures rotary wing vehicle (RWV) technologies for Army / DoD rotorcraft for increased strategic and tactical mobility / deployability; improved air-to-ground and air-to-air combat effectiveness; improved fire power; increased aircraft and aircrew survivability; increased reliability; reduced maintenance; and increased combat sustainability. This project supports the Objective Force and Joint Vision 2020 by providing maturing technology to improve tactical mobility, reduce the logistics footprint, focus combat power on multiple targets, enhance near-real time situational awareness, and increase survivability for rotary wing vehicles. Areas of research are focused on fluid mechanics, dynamics, weight reduction, advanced materials applications, infrared (IR) / visual electro-optical (EO) signatures, external cargo handling, combat damage repair, vulnerability reduction, ballistic tolerance and crashworthiness. These technologies will provide higher performance, improved survivability, improved sustainability, and reduced cost for propulsion and air vehicles. The propulsion component technology matured in this project provides improved specific fuel consumption, horsepower to weight ratios, and operation & support (O&S) savings for current and future rotorcraft engines. Advanced active controls, aerodynamics, handling qualities, acoustic signature attenuation and smart materials (materials that respond to specific stressors) technologies will provide rotors and flight controls with increased payload / range, maneuverability / agility and survivability. Flight simulation, avionics, weapons integration, aircrew / machine integration and pilot-vehicle interface technologies are focused on maturation of advanced crew stations and mission equipment packages that will provide improved workload distribution, reduced design / development time, and increased lethality and mission operational effectiveness. This project will begin demonstration of the Unmanned Combat Armed Rotorcraft (UCAR), a long endurance, armed, rotary wing platform. UCAR will be capable of performing suppression of enemy air defense (SEAD) and, like Comanche, putting weapons on a target using Loitering Attack Munitions-Aviation (LAM-A). This project also supports work done by NASA and 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 matured by industry and evaluated and approved by government on an annual basis to ensure they are supportive of DoD rotary wing goals and objectives. Technologies matured by this project will transition to advanced development technology demonstration programs with application to current as well as future Army / DoD rotorcraft systems. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

PROJECT  
**47A**

**FY 2000 Accomplishments**

- 7176 - Evaluated Variable Geometry Advanced Rotor Technology (VGART) core concepts applicability, based on initial small-scale authentication testing. Conducted parametric analysis (of potential VGART dimensions) to determine core concept technology mix potential for transition to 6.3 Variable Geometry Advanced Rotor Demonstration (VGARD) program.

  - Fabricated large-scale critical components and began bench tests for VGART core concept candidates.
  - Evaluated core concept initial wind tunnel data to guide variable geometry rotor candidate selection and prioritization for VGARD.
- 6694 - Conducted comprehensive flight test validation of Aero Design Standard (ADS)-33 requirements applied to the UH-60 with and without a sling load.

  - Integrated Rotorcraft-Aircrew Systems Concepts Airborne Laboratory (RASCAL) flight control laws in hardware in-the-loop development facility using Real-Time Interactive Prototype Technology Integration/Development Environment (RIPTIDE) modeling, control system analysis and piloted simulation environment.
  - Conducted detailed analytical study of control law concept for advanced rotor control based on 2/ revolution inputs to active pitch links for performance improvement.
  - Validated Control Designer's Unified Interface (CONDUIT) flight control design tool on successful flight tests of unmanned aerial vehicle (UAV) control laws for autonomous Vertical Takeoff UAV (VTUAV) (Schweitzer 330SP) and Burro (KMAX). Completed maturation, continued verification and validation of Man-Machine Integrated Design and Analysis System (MIDAS) human operator models. Tool transitioned to industry through cooperative R&D agreements.
  - Created and analyzed conceptual designs of advanced rotorcraft in response to evolving Objective Force operational concepts. Provided advanced rotorcraft designs in support of Army Science Board studies and the Overarching Rotorcraft Commonality Assessment (ORCA) study sponsored by the Joint Staff.
  - Compiled a comprehensive reference set of mission avionics functional requirements and future operational capabilities for current rotorcraft upgrades and projected aviation systems. Drafted preferred set of open system architecture specifications and standards, the Rotorcraft Technical Architecture, based on high volume Commercial Off-the-Shelf (COTS) electronics components.
- 5994 - Completed component maturation / test / validation and transition of NRTC technology to government / industry partners in the areas of: helicopter maneuver loads, active/passive noise control technology for helicopter interiors, vacuum-based resin transfer molded tailrotor blade, planetary ring gear design technology, high speed blade core carving process, simulator evaluation of synthetic vision and decision aiding tools, crashworthy fuel tank methodology, and vibration/stress reduction in airframes.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

PROJECT  
**47A**

**FY 2000 Accomplishments (Continued)**

- Conducted NRTC advanced technology maturation efforts in the areas of low cost and efficient composite structures, fan-in-fin unsteady aerodynamics, reduced manufacturing and operating costs, rapid prototyping tool fabrication technology, health and usage monitoring (HUM) technology, variable speed vapor cycle system and advanced applications of a 3-axis sidestick controller.
- 2732 - Completed preliminary concept screening, design, and fabrication of lightweight, high-efficiency engine infrared (IR) suppressor components that reduce suppressor weight by 20%
  - Conducted detailed comparisons of predictive vs. test structural behavior based on results of full-scale crash tests and executed software code modifications where necessary; performed component test and evaluation to support load adaptive (sensing system that responds to specific stressors) crashworthy landing gear strut for 40% increased gear energy absorption; performed analysis of crashworthy fuel system components and alternative materials to support 30% system weight reduction.
- 2041 - Evaluated use of smart materials for a variety of airframe applications where passive structural tuning can provide vibration control.
  - Identified technologies applicable to adaptive landing concepts, which extend the energy absorbing capabilities of current technology gear by 50%.
  - Defined advanced structures technologies and fabrication concepts that can reduce the assembly labor of complex composite parts by 50% and completed the preliminary design of the test article.
- 1330 - Completed rig testing of ceramic low pressure (LP) turbine; completed combined rig testing of advanced high pressure (HP) compressor for validation of improved pressure ratio capability and reduced weight; completed fabrication and rig testing of advanced ceramic matrix composite (CMC) combustor; completed detailed design of high strength, lightweight shaft providing a reduction in the number of bearings required; completed detailed design of advanced fuel control providing improved engine/airframe performance and affordability to future turbine engines; performed design of advanced inlet particle separator providing increased separation efficiency and durability and reduced engine losses.

Total 25967

**FY 2001 Planned Program**

- 7036 - Conduct analytical / simulation validation of active / passive external cargo load stabilization allowing higher operational speeds and flight test evaluation of CONDUIT / RIPTIDE optimized control laws to achieve a high bandwidth in-flight simulation capability.
  - Conduct initial study of analytical / simulation study of interactions of flight control and Individual Blade Control (IBC) rotorcraft control.
  - Mature hardware and perform flight test evaluation using RASCAL of envelop limiting / cueing concepts.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602211A - Aviation Technology**

PROJECT

**47A**

## FY 2001 Planned Program (Continued)

- Validate partial authority flight control concepts, providing attitude command/attitude hold capability with existing partial authority actuators in a joint flight test experiment in National Research Council (NRC) in-flight simulator (Ottawa, Canada).
- Evaluate MIDAS human operator models. Transition tool to industry through cooperative Research & Development agreements and/or commercialization partner. Apply operator models to follow-on empirical work in obstacle avoidance displays.
- Create and analyze conceptual designs of advanced rotorcraft in support of activities like the Army Science Board and the Integrated Concept Team (ICT) for the Future Transport Rotorcraft (FTR).
- Authenticate a COTS based, open systems mission processor hosting Apache Longbow operational flight program (OFP) applications in an Apache-like laboratory environment. Use COTS operating system and open graphics language as the host software environment. Integrate the mission processor with the network components (data buses, network interfaces, switches) and authenticate performance with Comanche OFP applications in a Comanche-like laboratory setting.
- 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 6.3 VGARD program.
  - Complete core concept applicability based on small scale validation testing.
  - Conduct active on-blade control loads modeling tools upgrade for transition to 6.3 VGARD concept mix and pre-design requirements.
- 6150
  - Conduct component maturation / test / validation and transition of NRTC technology to government / industry partners in the areas of: rotorcraft performance improvement and exterior noise reduction, improved prediction methods for complex rotorcraft applications, tiltrotor shipboard handling qualities improvements, carefree maneuvering technology, damage tolerance, crashworthiness and advanced structures, advanced low-cost composite manufacturing, advanced high speed machining of complex rotorcraft components, rotorcraft transmission casting technologies, and titanium high-speed machining.
  - Perform NRTC advanced technology maturation efforts in low noise, improved bevel gear design concepts, advanced transmission technology, variable speed vapor cycle system, health and usage monitoring (HUM) smart transducer data bus maturation, antenna technology, composite durability and damage tolerance, non-deterministic fatigue life methodology, and integrated helicopter design technology.



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

June 2001

BUDGET ACTIVITY

2 - APPLIED RESEARCH

PE NUMBER AND TITLE

0602211A - Aviation Technology

PROJECT

47A

## FY 2001 Planned Program (Continued)

- 2710 - Authenticate full-scale, light weight, high-efficiency engine IR suppressor; perform low-energy dynamic impact testing of load adaptive 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; affirm 50% assembly labor reduction for complex composite rotorcraft assemblies; apply smart materials to adaptive airframe structures to reduce vibration; mature more accurate structural load predictions to reduce airframe weight and development time; evaluate durable composite rotorcraft structural concepts to reduce weight and operational costs.
  - Screen low glint canopy coating material specifications.
- 2450 - Design and authenticate smart material actuator and global control schemes that can alter the structural response of an airframe in-flight in response to changing mission conditions.
  - Utilize modeling and simulation to predict the performance and screen candidate adaptive landing gear concepts; conduct design support tests on most promising concept.
  - Identify smart material/actuator technology that can be integrated into adaptive helicopter airframe structure for active control of loads/vibration; screen innovative technologies applicable to high reliability control signal and power requirements of evolving advanced rotor concepts.
- 1480 - Fabricate high strength, lightweight shaft providing a reduction in the number of bearings required; fabricate advanced fuel control providing improved engine/airframe performance and affordability; design advanced inlet particle separator providing increased separation efficiency and durability and reduced engine losses; design advanced power turbine providing increased cycle efficiency and reduced stage count.
- 400 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 27249

## FY 2002 Planned Program

- 9087 - Install test monitoring equipment on aircraft and perform flight test planning for passive external load stabilization.
  - Affirm significant improvement in agility and all-weather operations using rotor state feedback in RASCAL.
  - Conduct wind tunnel test of integrated flight/rotor control using on-blade flaps.
  - Perform simulation/flight test validation of autonomous guidance control laws using unmanned rotorcraft and piloted simulation quantifying benefit of "high situation awareness" rotorcraft cockpit displays emphasizing obstacle/traffic avoidance.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

PROJECT  
**47A**

**FY 2002 Planned Program (Continued)**

- Flight validate tactile cueing (real-time feedback of aircraft limits to pilot's sidestick controller)/active sidestick benefit for rotorcraft maneuver limiting.
- Produce rotorcraft primary flight display symbology aeronautical design guide, incorporating findings from other services/government labs.
- 6610 - Conduct component maturation / test / validation and transition of NRTC technology to government / industry partners in the areas of: rotorcraft interior noise reduction, rotorcraft interactional aerodynamics, rotorcraft performance improvement, carefree maneuvering technology, enhanced handling qualities for night operations, limited authority flight control technology, damage tolerance, crashworthiness and advanced structures, advanced low-cost composite manufacturing, structural joining technologies, rotorcraft transmission casting technologies, and enhance non-destructive engineering development.
- Perform NRTC advanced technology maturation efforts in improved bevel gear design concepts, advanced transmission technology, HUM smart transducer data bus maturation, antenna technology, composite durability and damage tolerance, non-deterministic fatigue life methodology, and integrated helicopter design technology.
- 4118 - Evaluate active on-blade control loads modeling upgrade for application to 6.3 VGARD design requirements and bench-test advanced actuator concept for swashplate-less rotor application.
- 5000 - Conduct applied research for rotorcraft UAV with industry, academia, and NASA through the NRTC.
- 3721 - Build and validate super lightweight thermal insulation components that reduce density by 50% over current state-of-the-art COTS insulation. Conduct analytic screening of advanced aircraft camouflage designs that reduce visual signatures in both desert and vegetated environments by 50% compared to current coatings.
- 2568 - Design, modify, test full-scale adaptive landing gear shock strut to affirm a 50% improvement in crash energy attenuation.
- Perform detailed design of control and actuation concepts for an adaptive structure concept capable of reducing airframe loads/vibration at a 50% reduction in weight penalty compared to current parasitic approaches.
- Conduct detailed design of high reliability adaptive structure hardware for transferring flight critical control signals.
- 12735 - Develop and evaluate NASA and NRTC designs for UAV heavy-fuel piston engines.
- Develop and validate NASA and NRTC simulation models for candidate Unmanned Combat Armed Rotorcraft (UCAR) airframe concepts.
- Define NASA and NRTC candidate autonomous modes of operation for UCAR.
- Develop NASA and NRTC human systems interface alternatives for implementation in UCAR.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

PROJECT  
**47A**

**FY 2002 Planned Program (Continued)**

- Develop concepts for integrating air-to-ground sensors, designators, and Netfires (LAM-A and PAM-A) to demonstrate cooperative manned-unmanned systems capabilities.
- Develop real-time synthetic vision-based guidance and trajectory capability for precision maneuvering in combat.
- 1745 - Test Metal Matrix Composite (MMC) shaft and validate weight reductions; upgrade simulation software/hardware and perform final closed loop bench test of advanced fuel control; design and fabricate advanced inlet particle separator providing increased separation efficiency and durability and reduced engine losses; design advanced power turbine providing increased cycle efficiency and reduced engine weight; design advanced compressor providing high pressure ratio in lightweight, low cost design.

Total 45584

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

PROJECT  
**47B**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
47B VEH PROP & STRUCT TECH	3246	3545	3681	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Vehicle Propulsion and Structure Technology project matures engine, drivetrain and airframe technologies for Army / DoD rotorcraft that significantly increase strategic and tactical mobility/deployability, increase reliability, reduce maintenance costs and increase combat sustainability. The problems being addressed in propulsion technology include increased fuel efficiency and reduced propulsion systems weight. Technical barriers include temperature limitations for materials, accurate modeling for flow physics, and accurate prediction of propulsion system mechanical behavior. The problem being addressed in structures is the inability to design for acceptable reliability and durability with current tools, which leads to heavier, more costly designs and poor life cycle management. Technical barriers include inadequate structural analysis design tools, inadequate structural dynamics modeling methods for the rotating and fixed system components, incomplete loads/usage data, and inaccurate inspection and tracking methodologies. Technical solutions are pursued through: 1) propulsion research focused on fluid mechanics, high temperature materials, and mechanical behavior for significantly improved small airflow turbine engines, transmissions, and gears, bearings, and shaft components for advanced drivetrains at significantly reduced weight and cost; and 2) structures research focused on aerodynamic loads, aeroelastic interactions, integrated composites, structural integrity, low cost manufacturing and crashworthiness that will provide improved rotor and airframe structures subsystems. This propulsion research supports the goals of the DoD integrated high performance turbine engine technology (IHPTET) / Joint Turbine Advanced Gas Generator (JTAGG) program. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1829 - Validated a 30% extension in centrifugal compressor flow range through controlled airflow injection, which offers the potential for substantial improvements in compressor design and fuel efficiency.
  - Analyzed advanced concept configuration for close coupled, compact 2-stage compressor system; and completed a multi-stage computational fluid dynamics (CFD) assessment that shows that the configuration out-performs current practice.
  - Completed design and construction of cooled ceramic matrix composite turbine nozzle airfoils for application to IHPTET/JTAGG phase III.
  - Completed rotordynamic feasibility and conceptual design analysis of bearing system for oil-free small turbine engine core.
  - Completed installation of unique, world-class, high temperature gas path seal rig facility.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

PROJECT  
**47B**

**FY 2000 Accomplishments (Continued)**

- Completed successful testing of silicon carbide (SiC) compressor pressure sensor and lateral resonators up to 400°C and 950°C, respectively.

- 1417 - Investigated active control technology for stability augmentation of soft inplane tiltrotor in hover, and conducted first Transonic Dynamics Tunnel tests of 'active twist' rotor model for vibration control.
- Investigated Regenerative Electronics' power and control system to assess use with on-blade rotor system actuators.
- Completed tension-torsion fatigue testing of Bell ducted tail rotor flexbeam to correlate with finite element analysis (FEA) predictions and FEA and tension-bending tests of hybrid composite flexbeam laminates to validate failure criteria.
- Evaluated barely visible impact damage test and analysis methods for thin-skin composite sandwich structures.
- Completed local 2D - global 3D analysis for delamination from matrix cracks in stringer pull-off specimens and FEA and establishment of combined load test specimens and conducted testing of tailored composite panels.
- Validated microwave non-destructive evaluation (NDE) for moisture detection in adhesively bonded composite panels to determine relationship between moisture content and bond quality.

Total 3246

**FY 2001 Planned Program**

- 2131 - Conduct air injection feedback control experiments on a centrifugal compressor stage to improve turbine engine performance by extending its stable operating range.
- Evaluate engine components for a compact two-stage compressor to reduce engine size and weight.
- Evaluate cooled ceramic matrix composite turbine nozzle airfoil to support IHPTET very high temperature operating requirements.
- Complete thermal management assessment of the advanced helical gear drive system and SiC pressure sensor for engine component applications that will contribute to drive train and advanced engine reliability and durability.
- Conduct engine combustor and compressor simulations using improved software to validate substantial reductions in engine design time.
- 1397 - Assess aeroelastic stability of variable diameter tiltrotor concept in support of the Vertical Take-off and Landing capability for the Objective Force.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602211A - Aviation Technology**

PROJECT  
**47B**

## FY 2001 Planned Program (Continued)

- Conduct initial closed-loop hover tests of active twist rotor and prepare for forward flight closed-loop tests for improved rotor vibration control.
- Evaluate use of "Regenerative Electronics" power and control system with on-blade rotor system actuators to improve response time performance and reliability.
- Evaluate bondline interfacial effects on adhesive bond strength of composite structures for improved vehicle structural reliability.
- Validate strength and stiffness predictions of tailored composite panels to improve the prediction accuracy for future tiltrotor thin wing designs.
- 17 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3545

## FY 2002 Planned Program

- 2020
  - Conduct experiments using innovative Micro Electro Mechanical Sensor (MEMS) air injection technology (zero net mass flow) in the diffuser of a centrifugal compressor to extend compressor stability operating range.
  - Conduct performance experiments on compact high performance two-stage compressor to enable reduced engine weight and size.
  - Optimize processing parameters for fabrication of ceramic matrix composite turbine nozzles in support of high temperature IHPTET requirements.
  - Complete baseline experiments of unique, high speed/high temperature gas path seal rig to enable reduction of engine secondary air flow losses, thereby improving efficiency.
  - Complete thermal experiments on alternate high-speed helical gear design to enhance future drive system reliability.
- 1661
  - Assess the 'closed-loop' control actuation capability of Active Twist Rotor (ATR) for vibration reduction and determine its potential for noise reduction.
  - Investigate concepts for a Low Cost Active Rotor (LCAR) which provides for "Full Authority" control, eliminating the need for a rotor swashplate.
  - Perform comparison studies of soft-inplane blade and hub loads versus conventional stiff-inplane hub to improve understanding of the tiltrotor stability boundary and to extend its performance envelope and investigate 3D finite element model of hybrid rotor hub flexbeam concept for improved rotorcraft structural integrity.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602211A - Aviation Technology**

PROJECT

**47B**

**FY 2002 Planned Program (Continued)**

- Perform component experiments using thermal non-destructive evaluation (NDE) measurements to correlate bondline geometry with bond strength for an improved understanding of vehicle structural reliability and durability.
- Investigate airframe concepts for application to large-scale, pressurized rotorcraft fuselages in support of the Objective Force rotorcraft.

Total 3681

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

**June 2001**

**BUDGET ACTIVITY**  
**2 - APPLIED RESEARCH**

**PE NUMBER AND TITLE**  
**0602270A - EW Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	16602	22007	17449	0	0	0	0	0	0	0
442 TACTICAL EW TECHNOLOGY	9374	9814	10119	0	0	0	0	0	0	0
906 TAC EW TECHNIQUES	7228	7338	7330	0	0	0	0	0	0	0
91F MULTIPLE INTEL REMOTED SENSOR SYSTEM - 2ND GEN	0	4855	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) researches and investigates Electronic Warfare (EW) technologies to improve the Army's Objective Force battlespace Situational Awareness (SA), targeting, Battlefield Assessment (BA), and enhanced Force Protection. This PE will deny, disrupt, or degrade the enemy's use of the electromagnetic spectrum for offensive or defensive operations. Specifically, its technologies focus on detection, identification, geolocation and Battlefield Electronic Mapping of threat emitters associated with weapon guidance systems, targeting systems and Command, Control, Communications, Computers and Intelligence (C4I) systems and networks. Sensor and related research and advanced technology development will focus on a small, self-configuring family of modular sensor products capable of being hosted on a core monitoring and control architecture. This PE covers the spectrum in the Radio Frequency (RF), Infrared (IR), Electro-Optical (EO), and Ultra-Violet (UV) ranges. This PE offers improvements to our EW sensors, and Electronic Countermeasures (ECM) systems to further protect high-value ground targets, aircraft, and the soldier from threat surveillance/tracking systems, imaging systems and advanced RF/EO/IR missiles, artillery, and smart munitions. Next generation EW protection sensors augment the classic Intelligence, Surveillance, And Reconnaissance (ISR) sensors by providing multi-functional capabilities for on-board, and off-board SA, targeting, and combat identification. Finally, this PE will research automated intelligence fusion and automated battlefield assessment management tools. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, the Future Combat Systems and Project Reliance. It adheres to the Tri-Service Reliance Agreements on Intelligence And Electronic Warfare (IEW). It is related to and fully coordinated with efforts in PE 0602782A (Command, Control and Communications (C3) Technology), PE 0602709A (Night Vision and Electronics-Optics Technology), PE 0603789F (C3 Intelligence Technology Development), PE 0603270A (Electronic Warfare Advanced Technology), PE 0604270A (Electronic Warfare Development), and PE 0603745A (Tactical Electronics Support Systems - Advanced Development). The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command (CECOM), Fort Monmouth, NJ.



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602270A - EW Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	17402	17310	18378	0
Appropriated Value	17487	22210	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-300	0	0	
c. Omnibus or Other Above Threshold Reductions	-46	0	0	
d. Below Threshold Reprogramming	-500	0	0	
e. Rescissions	-39	-203	0	
Adjustments to Budget Years Since FY2001 PB	0	0	-929	
Current Budget Submit (FY 2002/2003 PB )	16602	22007	17449	0

In FY2001, Congressional add was received for Multiple Intelligence Remoted Sensor System (\$4900).  
 -(\$4900) Design block two enhancements (e.g. advanced transducers, multiple access methods, enhanced networking) to the block one Multiple Intelligence Remoted Sensor System baseline.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602270A - EW Technology**

PROJECT  
**442**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
442 TACTICAL EW TECHNOLOGY	9374	9814	10119	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project researches, investigates and applies technologies to provide self protect capabilities to the Objective Force and Future Combat Systems (FCS). The intent is to use RF, IR and EO technologies to detect, identify, locate, and employ countermeasures against threat systems. Specifically, this project will investigate the use of RF technologies against radar directed target acquisition, target-tracking sensors, Surface-to-Air Missiles (SAMs), Air-TO-Air Missiles (AAMs), top attack and fuzed munitions. It also will investigate and apply IR technologies against heat seeking SAMs, AAMs and Anti-Tank Guided Missiles (ATGMs). Additionally, this project will focus on EO technologies against laser-aided and electro-optically directed gun or missile systems. Finally, this project will look at those Electronic Support (ES) technologies used against non-communications signals for targeting and tactical SA. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1399 - Investigated, in conjunction with Defense Advanced Research Projects Agency (DARPA), Air Force (AF) and Navy laboratories, augmenting legacy radios with evolving digital software technology that will provide the capability to receive, classify and support information from a variety of sources for use by tactical maneuver vehicle commanders.
  - Identified front-end and processing hardware for software radios.
  - Conducted preliminary design study of Single Channel Ground and Airborne Radio System (SINCGARS) based radio location sensors.
  - Evolved Battle Lab scenario simulations to evaluate warfighter benefits from, and to mature operational concepts for, an alerting and collecting system for tactical maneuver vehicle commanders.
- 778 - Used DARPA high-speed analog-to-digital converter technology to evolve ultra-wide bandwidth digital RF memory module that deceives and jams a variety of enemy radars.
  - Coordinated with Naval Research Lab (NRL) and Air Force Research Lab (AFRL) the development of software for digital RF memory.
- 1925 - Investigated the missile warning applications of low cost sensor technologies and corresponding warning algorithms common to air and ground platforms.
  - Conducted field measurements of the IR and UV signatures of surface-to-air missiles, ATGM's, background and man-made point false alarm sources.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602270A - EW Technology**

PROJECT

**442**

## FY 2000 Accomplishments (Continued)

- 2934 - Investigated multi-band Ultra Violet (UV) and IR countermeasures to emerging multispectral surface-to-air and air-to-air missiles (SAMs and AAMs).
  - Enhanced jammer laboratory to study advanced IR countermeasure techniques for advanced ATGMs.
- 2338 - Designed conformal and low observable, multi-octave antenna technology for upgrades to RF and missile warning systems.
  - Upgraded and tested RF threat simulator capabilities in the System Integration Laboratory (SIL).
  - Upgraded SIL's data links to the battle labs and schools for interactive simulations using RF countermeasure systems.
  - Studied, with NRL and AFRL, techniques for designing an RF deception and countermeasures testbed based on analysis of next generation Electronic Warfare (EW), electronic intelligence (ELINT), and communications intelligence (COMINT) threats.

Total 9374

## FY 2001 Planned Program

- 3419 - Investigate conformal and low observable, multi-octave antenna technology for upgrades to RF and missile warning systems.
  - Test SIL's upgraded data links with battle labs and schools for interactive simulations using RF countermeasure systems.
  - Design RF deception and countermeasure techniques testbed.
  - Conduct additional field-testing of radar countermeasures under technical panels 1 and 2 of the Technical Cooperation Program Electronic Warfare Simulator.
  - Evaluate enhancements in detection and location capabilities through the integration of COMINT and ELINT.
- 1914 - Evolve the missile warning applications of low cost sensor and corresponding warning algorithms common to air and ground platforms.
  - Conduct field measurements of IR and UV signatures of SAMs, ATGMs, background and manmade point false alarm sources.
- 2894 - Investigate warning algorithms for 2-colored ATGMs and evaluate IR countermeasures to advanced ATGMs and emerging SAMs and AAMs including focal plane array (FPA) imaging missiles.
  - Evaluate cooperative jamming and decoy/flare techniques to support a demonstration of integrated countermeasures against ATGMs and SAMs.
  - Design, in coordination with DARPA and Tri-Service Technology Panel for EW (TPEW), a multispectral laser to counter missile seekers and trackers.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602270A - EW Technology**

PROJECT  
**442**

## FY 2001 Planned Program (Continued)

- 1426 - Evolve antennas and RF collectors for airborne and ground tactical maneuver vehicles.
  - Integrate spread spectrum receiver technology for eventual transition to countermeasure systems.
  - Perform research to provide ES technology to intercept, geolocate, and counter emerging hostile non-communications emitters on the battlefield.
  
  - Participate in a Battle Labs distributed simulation demonstration that will evolve radio software algorithms to refine their operational concepts and improve signal mapping visualization and analysis tools.
  - Evolve advanced antennas, and collection and mapping capabilities of micro electromechanical systems (MEMS) low voltage switch technology.
  
  - Evolve SINGARS for radio location sensor.
  - Evolve electronic mapping SIGINT object model using artificial intelligence algorithms and digital signal processing (DSP) based optimization techniques.
- 161 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9814

## FY 2002 Planned Program

- 1557 - Mature & test an advanced wavelet based algorithm for simulation of specific emitter identification (SEI).
  - Conduct multi-function electronic collection and mapping system simulation using a combination of field experiments and operational workstation demonstrations.
- 3710 - Research and conduct simulation of innovative RF countermeasures capabilities with SIL and Battle Labs.
  - Utilize RF countermeasures testbed to test deception techniques against targeting and air defense radars.
  - Research techniques against frequency hopping air defense radars and top attack munitions.
  - Conduct SIL testing of countermeasures against artillery top attack fuzes.
- 2878 - Transition warning algorithms for 2-colored ATGMs to FPA missile warning program. Demonstrate IR countermeasures to advanced ATGM's and emerging surface-to-air and air-to-air missiles including FPA imaging missiles.
  - Demonstrate cooperative jamming and decoy/flare techniques to support integrated countermeasure technology demonstration.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602270A - EW Technology**

PROJECT  
**442**

**FY 2002 Planned Program (Continued)**

- Research multispectral laser to defeat advanced IR surface-to-air and imaging missiles.
- Mature IR jammer to defeat advanced ATGMs.
- 1974 - Research, mature and test the missile warning applications of low cost sensor and corresponding warning algorithms common to air and ground platforms.
- Continue field measurements of IR and UV signatures of surface-to-air missiles, ATGMs, background and manmade point false alarm sources.

Total 10119

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602270A - EW Technology**

PROJECT  
**906**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
906 TAC EW TECHNIQUES	7228	7338	7330	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The project researches and applies key EW technologies to intercept, and locate current and emerging threat communications emitters in accordance with concepts for Objective Force intelligence operations. The results are used for targeting, tactical situation awareness, and disruption/destruction of C4I systems. This project matures RF collection and mapping technologies into integrated multifunction devices, to offer real time emitter detection, location, and identification. It also evolves Electronic Attack (EA) components into smaller, lower power, lightweight, common modules that counter modern threat C4I systems. In addition, this project will enable a remote capability to disrupt, deny or destroy of threat communication signals. Other research areas include fusion (automated assimilation and synthesis) of battlefield intelligence data, and brigade level joint ISR capability to address operational shortfalls. Fusion and dissemination efforts will integrate data from traditional intelligence sensors and non-traditional sources, such as target acquisition systems, to provide ground force commanders unprecedented battlefield awareness and dominance of the electro-magnetic spectrum. This system supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2000 - Modified existing testbed to emulate adversary digital communication networks, computer-based networks, and tactical information systems. Identified and assessed the vulnerabilities and susceptibilities of RF and wired networked components.
  - Performed exploitation and attack strategies against the RF and wired network components in the enhanced testbed.
- 3892 - Evolved 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.
  - Enhanced technologies to integrate, disseminate, and display intelligence data from tactical and national assets necessary to provide/enhance SA of red forces at the brigade level.
  - Investigated 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.
- 1336 - Surveyed sources of data to be displayed and determined connectivity to national assets.
  - Adapted electronic mapping object models to display information.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602270A - EW Technology**

PROJECT  
**906**

**FY 2000 Accomplishments (Continued)**

- Evolved target set to identify priorities of targets.
- Modeled concurrent collection/communication function with tactical internet.

Total 7228

**FY 2001 Planned Program**

- 1113 - Generate exploitation and attack capability against identified vulnerabilities and susceptibilities of adversaries' emerging communications networks, tactical information systems, and computer based networks.  
- Leverage commercial-off-the-shelf (COTS) technologies to mature the capability to assess tactical network security. Utilize these assessment techniques to evaluate the current tactical internet (TI) architecture.
- 1996 - Evolve software products that integrate existing joint and national intelligence sensors, provide a common format for integration of sensor information and provide a common SA of enemy forces for the brigade commander.  
- Evolve neural network tools to provide the capability to intercept emitters 90% of time, when 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 SA.
- 4150 - Integrate electronic mapping of SIGINT object models into workstations.  
- Generate advanced algorithms using digital signal processing (DSP)-based optimization techniques and artificial intelligence (AI) sensor-cueing.  
  
- Mature prototype of a multi-function RF collector.  
- Evolve signal collection, mapping, analysis and visualization tools for auto-detection, templating, and Battle Lab prototyping.  
- Participate in a Battle Lab distributed simulation demonstration that will evolve radio software algorithms to refine their operational concept and improve signal mapping visualization and analysis tools.
- 79 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 7338

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602270A - EW Technology**

PROJECT  
**906**

## FY 2002 Planned Program

- 530 - Integrate exploitation and attack capabilities onto an identified common operating platform.  
- Utilize tactical network security assessment techniques to delineate needed upgrades to tactical internet security architecture. Use findings to establish countermeasures and self-protection strategies.
  - 4200 - Mature advanced wavelet based algorithms for SEI. Test in digital receiver testbed.  
- Interface low profile direction finding antennas. Test as back-up to omni-directional antenna/TDOA emitter location.  
- Conduct a lab based multi-function electronic collection and mapping simulation using a combination of field experiments and operational workstation demonstration.
  - 2100 - Complete software to integrate existing joint and national intelligence sensors into a common format.  
- Complete baseline neural network tools to optimize sensor cross-cueing for a 90% or greater capability to intercept emitters.
  - 500 - Battlefield Electronic Mapping leveraging inputs from multiple intelligence sensors.
- Total 7330



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

COST (In Thousands)	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cost	53431	70076	40112	0	0	0	0	0	0	0
214 MISSILE TECHNOLOGY	38566	51209	40112	0	0	0	0	0	0	0
223 AERO-PROPULSION TECHNOLOGY	12409	18867	0	0	0	0	0	0	0	0
340 SWORD	2456	0	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This applied research program element investigates advanced technologies for missiles, rockets, and unmanned vehicles for use on the Future Combat Systems (FCS) and the Objective Force. Major technology areas include missile guidance systems, air defense acquisition systems, multi-spectral seekers, high fidelity simulations, missile aerodynamics and structures, and missile propulsion. The overall objectives are to increase the survivability of launch systems; provide greater lethality and effectiveness under adverse battlefield conditions; increase kill probabilities against diverse targets; and provide powerful new simulation and virtual prototyping analysis tools. As Compact Kinetic Energy Missile (CKEM) technologies mature, demonstrations will be conducted under PE 0603313A (Missile and Rocket Advanced Technology). The CKEM program transitions in FY02-03 to the advanced technology demonstration phase. Another effort in this PE is the high-g, low cost, Micro Electro-Mechanical Systems (MEMS) Inertial Measurement Unit (IMU) program. This effort will provide MEMS IMU's for precision guidance of missile and munitions. This program is a collaboration with the Armament Research and Development and Engineering Center. Funding has been increased in FY02-05 and FY07 to complete the design, demonstration, and testing for this effort.

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). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan (AMP) and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Aviation & Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	47939	47183	30029	0
Appropriated Value	48392	70683	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-963	0	0	
c. Omnibus or Other Above Threshold Reductions	-148	0	0	
d. Below Threshold Reprogramming	3999	0	0	
e. Rescissions	-349	-648	0	
OSD Realignment	2500	0	0	
Adjustments to Budget Years Since FY2001 PB	0	0	10083	
Current Budget Submit (FY 2002/2003 PB )	53431	70035	40112	0

Change Summary Explanation: Funding: FY 2000: a one-year Congressional add was received for:

- Project A340, Short Range Missile Defense with Optimized Radar Distribution (SWORD) (+2500) - This one-year congressional add investigated the technical feasibility of the SWORD interferometric radar.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

In FY 2001, one-year Congressional adds were received for:

- Project A214: Low Cost Guidance and Navigation Set (+4500) - This one-year Congressional add completes phase one of the Low Cost Guidance and Navigation set. This effort will complete fabrication of a first generation prototype Global Positioning System/Inertial Measurement Unit (GPS/IMU).
- Project A223: Accelerated Dev/Test Tactical Missile Components (+8000) - This one-year congressional add completes component design and testing of advanced missile components for hypersonic missile airframes.
- Project A223: Aero-Optic Evaluation Center (AOEC) (+3500) - This one-year congressional add upgrades test capabilities of the aero-optics evaluation center and performs aero-thermal, aero-optics, aerodynamics, and aero-acoustics tests at hyper sonic flight conditions.
- Project A223: Enhanced Scramjet Mixing (+1500) - This one-year congressional add completes research of propulsion technology for potentially longer and faster flight of Army missiles.
- Project A223: Future Army Tactical Missile Integration Program (FMTI) (+6000) - This one-year congressional add completes design, integrate and test of components for future hypersonic missile systems.

In FY2002, project A214 was increased to develop a high-g, low cost MEMS IMU (+10083).

In FY2003, project A214 was increased to develop a high-g, low cost MEMS IMU (+10026).

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

PROJECT  
**214**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
214 MISSILE TECHNOLOGY	38566	51209	40112	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project focuses on missile and rocket technologies that support lightweight, highly lethal weapons concepts with greatly reduced logistics requirements for the FCS and Objective Force. Major technology areas investigated are missile guidance systems, air defense target acquisition systems; multi-spectral seekers; high fidelity simulations; missile aerodynamics and structures; and missile propulsion. Research objectives are to enhance the survivability of launch systems, provide greater effectiveness under adverse battlefield conditions, increase kill probabilities against diverse targets, and provide powerful new simulation and virtual prototyping analysis tools. The major effort in this project is the CKEM. This missile is a prime candidate to provide overwhelming lethality for the FCS Direct Fire System with increased stowed rounds. The CKEM program schedule has been aligned with the FCS schedule. The funding for this program was increased in FY01 and FY02 to accelerate component testing to ensure that a prototype is ready for insertion into the FCS demonstrator in FY04. As efforts in this project mature, work is transitioned to PE 0603313A (Missile and Rocket Advanced Technology) to support demonstrations of capabilities for CKEM and Common Missile. Another effort in this project is the high-g, low cost, MEMS IMU program. This effort will provide MEMS IMU's for precision guidance of missile and munitions. This is a joint program with the Armament Research and Development and Engineering Center. Funding has been added in FY02-05 and FY07 to complete the design, demonstration, and testing for the MEMS IMU effort. Major contractors are Lockheed Martin, Dallas, TX; MILTEC/Boeing, Huntsville, AL; Raytheon Company, Tucson, AZ; and BAE Systems, Austin, TX. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 13494 - CKEM -Implemented Industry/Government cooperative programs for overall CKEM system engineering, design and analysis, and technology and component maturation. Awarded four (4) Phase I base contracts for system concept definition. Awarded multiple contracts for CKEM component and technology maturation in the areas of high-g guidance components and advanced propulsion.
- Performed testing to quantify secondary lethality effects and to substantiate a 25% increase in missile lethality with novel penetrators.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602303A - Missile Technology**

PROJECT

**214**

## FY 2000 Accomplishments (Continued)

- 14320 - Missile guidance systems - tower tested and evaluated automatic target recognition (ATR) hardware/algorithms in realistic battlefield environments to include smoke and countermeasures. Integrated and tested High Quantities Anti-material Submunition (HI-QUAMS) small laser radar (LADAR) seeker brassboard. Matured GPS jamming/spoofing models of inexpensive, small hardware for Army tactical missile application. Matured enhanced guidance link technology for loitering missiles and mini-unmanned aerial vehicles (UAVs). Devised counter-countermeasures for infrared imaging seeker countermeasures.  
- High fidelity system level simulations and aerodynamics - extended the field programmable gate array digital quadrature modulator for increased processor throughput and higher clock rates. Extended the Ka-band radio frequency (RF) front-end processor design of the RF target verification monitor to handle short RF pulses. Implemented parallel processing programmable "model board" software for real-time, dynamic representation of missile seeker input optics and target image sensed scene irregularities.
- 8310 - Smart, stealthy, smokeless missile propulsion and smart structures - fabricated final design of conformal optical dome and corrector elements, integrated with imaging IR seeker and performed imaging and tracking evaluations of conformal optical seeker that will provide the technology to significantly extend the range of tactical missiles. Completed maturation of improved fuel gel for long range, survivable, multi-mission capabilities. Matured and tested hydrogen chloride (HCl)-free propellants for minimum signature propulsion.  
- Focused technology integration - transitioned current Remote Readiness Asset Prognostics/Diagnostics System (RRAPDS) technology to PATRIOT Project Office, finalized functional requirements, and designed specifications for RRAPDS objective system which provides near real-time logistics situational awareness thereby significantly reducing operating and support costs. Developed motor performance requirements, identified turbojet maturation issues, and developed a design to adapt the DARPA Netfires Loitering Attack Munition (LAM) to rotary wing aircraft.
- 2442 - One year Congressional add completed Low Cost Guidance and Navigation Unit specifications for a small, inexpensive, jam-resistant global positioning system (GPS)/inertial navigator for multiple weapon applications including projectiles, missiles, vehicles, and aircraft.

Total 38566

## FY 2001 Planned Program

- 18819 - CKEM - Award contracts to mature the system design concepts and validate component technology.  
- CKEM - Perform detailed design and rebalancing as required to reflect the emerging results from the technology and component development effort. Define technical risk and develop a risk reduction plan; develop cost breakouts for elements; and develop objective/thresholds for key performance parameters in a Cost as an Independent Variable (CAIV) strategy.  
- CKEM - Perform system trades and assessments utilizing both 6-Degrees-of-Freedom and Force-on-Force models.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

PROJECT  
**214**

**FY 2001 Planned Program (Continued)**

- 6897 - High-G MEMS IMU - Perform research to mature sensor and electronic design, foundry processes, and testing at competing contractor facilities for advancement of affordable, high-G MEMS IMUs applicable to the requirements from both elements of the precision guided munition community: high-G from the gun community and high performance from the guided missile community. This is a cooperative Industry/Government program jointly managed by the gun and missile communities.
  - 7443 - Missile guidance systems - Combine two single axis MEMS-based angular rate sensors to form a dual axis sensor; ground test in military environments; and mature a prototype MEMS-based roll rate sensor that meets the FCS inertial sensors design requirements. Use collected data in flight simulations and performance assessments for applicability of ATR to relevant weapon systems. Test infrared imaging counter-countermeasures.  
  
 - High fidelity system level simulations and aerodynamics - Investigate infrared (IR) target signature models applicable to active IR target acquisition and tracking sensors. Devise methods and write 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 hardware-in-the-loop (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. Complete and demonstrate the target verification monitor with application to all types of Ka-band pulse and continuous wave (CW) radiation in a HWIL simulation facility.
  - 12398 - Smart, stealthy, smokeless missile propulsion and smart structures - Complete component maturation of flight type hardware and integrate into a brassboard. Test a flexible sustainer for long range, survivable, multi-mission capabilities. Complete vacuum aging study for service life prediction for cost avoidance of replacing propulsion systems and increased system safety and performance reliability. Devise methodology for aging assessment of gel propulsion systems.  
  
 - Focused technology integration - Design a digital system manager (DSM) and integrate with the sensor suite to optimize power consumption, and finalize and validate limited failure models for RRAPDS. Complete design to provide real-time targeting for short/medium range indirect fire munitions using a miniature (45-60 centimeter wingspan) aerial vehicle. Select approach and complete bench test prototype hardware to adapt the DARPA Netfires Loitering Attack Munition (LAM) to rotary wing aircraft.
  - 4433 - One year Congressional add to complete Low Cost Guidance and Navigation Unit fabrication of a prototype navigator including synchronous sampling, ultra-tightly coupled Global Positioning System/Inertial Measurement Unit (GPS/IMU), and full set of navigator functions able to meet Extended Range Gun Munition (ERGM) and XM982 155mm Extended Range Artillery Projectile form factors as well as those of larger missiles/vehicles.
  - 1219 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 51209

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

PROJECT  
**214**

**FY 2002 Planned Program**

- 10300 CKEM - Fabricate and test subsystems to define a basis for determining risk, achievable performance, and trade-offs between lethality/survivability and missile sizing.  
 - CKEM - Perform hardware-in-the-loop simulation testing under flight representative conditions to assess and reduce risk. Achieve a Technology Readiness Level (TRL) of 5.  
 - CKEM - Provide test results and assessments for the FCS Technology Readiness Decision in FY03.
- 10000 - High-G MEMS IMU - Perform detailed design and analysis of first generation devices, incorporating emerging results from development effort. Construct, evaluate, and refine manufacturability processes to begin production automation and process control maturation.
- 8815 - Missile guidance systems - Test a dual axis MEMS-based angular rate sensor (ARS) that incorporates technology developed by DARPA. Test in the laboratory and in a HWIL environment both the dual axis MEMS-based ARS and the single axis roll rate sensor. Design uncooled IR sensor for missile applications.  
 - High fidelity system level simulations and aerodynamics - Investigate designs for signal generation applicable to HWIL simulation of IR LADAR devices. Implement improved techniques for PC-based massively parallel computation of target RF signatures. Design and build databases of RF and IR target signatures suitable for multispectral HWIL simulation.
- 3732 - Smart, stealthy, smokeless missile propulsion and smart structures - Complete design, fabricate and test brassboard of a deep throttling booster that extends the capabilities of controllable thrust technology to increase range and provide multi-mission capability for a family of FCS and Objective Force weapon systems.
- 7265 - Focused technology integration - Integrate a "full-up" RRAPDS system sized TOW Fire and Forget missile which will have applicability to all tactical missiles to include CKEM, Common Missile, LAM, and LAM-A. Evaluate RRAPDS as an HTI candidate for a launch platform and a high value conventional munition. Evaluate ability to provide the user with target information on stationary and moving military vehicles using small unmanned aerial vehicles.

Total 40112

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

PROJECT  
**223**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
223 AERO-PROPULSION TECHNOLOGY	12409	18867	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This Congressionally directed project focuses on missile and rocket aero-propulsion technologies. It develops aerodynamics and related propulsion technologies and demonstrates enhanced range, maneuverability, and the survivability for missiles and UAVs. It explores unique aerodynamic characteristics and propulsion concepts to enhance missile flight performance at subsonic, supersonic, and hypersonic velocities. Current efforts include: scramjet, aero-optic evaluation facility, and computational fluid dynamics.

**FY 2000 Accomplishments**

- 1909 - Scramjet - tested a Scramjet missile propulsion concept in a ground test facility operating at full scale and at duplicated flight conditions.
- Provided Scramjet hardware for testing, analytical performance predictions, and data reduction and analysis.
- 2864 - Aero-Optic Evaluation Facility - Tested hypersonic missiles in a ground test facility operating at full scale and at duplicated flight conditions
- 7636 - Computational Fluid Dynamics (CFD) - developed a specialized computer system for designing and developing missiles and missile components using CFD.

Total 12409

**FY 2001 Planned Program**

- 3500 - Aero-Optics Evaluation Center (AOEC) - provide for upgrade of testing equipment and facilities for various endo-atmospheric missile systems. These tests will provide critical aero-optical, aero-thermal, aero-acoustics, and aerodynamic data prior to flight testing.
- 1500 - Enhanced Scramjet Mixing - provide for development and testing of concepts to enhance the mixing of the fuel/air streams of a supersonic combustion scramjet engine
- 8000 - Accelerated Development/Test of Tactical Missile Components - provide for development and testing of advanced technology components that can be integrated into future tactical missiles concepts.



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602303A - Missile Technology**

PROJECT  
**223**

## FY 2001 Planned Program (Continued)

- 6000 - Future Army Tactical Missile Integration Program - Provide integrated solutions through analysis and tests of multiple integrated advanced technology components that must operate in an environment that includes aero-interaction with the guidance, propulsion, and/or missile air frame.

Total 19000

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602303A - Missile Technology</b>					PROJECT <b>340</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
340 SWORD	2456	0	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** Over the past 10 years the US Army Ballistic Missile Defense Organization has been investigating the use of interferometry to develop a highly accurate radar system to use in defense of high value assets. The current SWORD concept uses this technology to support the counter air munitions defense mission and provide protection from saturation or simultaneous attack from ballistic rockets or artillery. The accuracy of the radar allow for removal of an interceptor seeker, therefore, reducing the cost of the overall system. Potential technical issues for this system concept were identified by the Deputy Assistant Secretary of the Army for Research and Technology (DAS(R&T)), who sponsored a SWORD Independent Review Team (IRT) effort. The SWORD Radar S&T Program addresses these issues by determining the magnitude of system and operational errors and developing mitigation techniques to reduce these errors to the operational requirement levels. This SWORD S&T Program has been endorsed by Office of the Secretary of Defense. If the SWORD Radar S&T effort is a success, the Army will evaluate the potential of a SWORD ATD. The work in this program is consistent with the Army spectrum of operations in the Chief of Staff, Army vision: deployable, agile, versatile, and lethal. Work is performed by SMDC, Huntsville, AL. Contracts have been awarded to Technovative Applications, Brea CA; Georgia Tech Research Institute, Atlanta GA; Amtec, Huntsville AL; and Delta Research, Huntsville AL.

**FY 2000 Accomplishments**

- 2446 The SWORD Science and Technology Program executed the Bench Test in FY00 that addressed wide bandwidth target spectral distortion and range gate straddle error sources. The SWORD Radar S&T Program has completed its first major milestone. Dr. Stotts, Director of Technology for the DAS(R&T), was briefed on the Bench Test results, High Fidelity Simulation Planning efforts, and the Single Channel Wide Band Receiver design. The Bench Test results came to the following conclusions: theory, simulation, and the bench test reveal that Target Spectral Distortion and Range Gate Straddle errors can be successfully mitigated to acceptable error levels by using short sample interpolation intervals at relative locations in the matched filter.

Total 2446

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602303A - Missile Technology**

PROJECT

**340**

**FY 2001 Planned Program**

Project not funded in FY 2001.

**FY 2002 Planned Program**

Project not funded in FY 2002.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602307A - Advanced Weapons Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	4000	6646	19043	0	0	0	0	0	0	0
042 HIGH ENERGY LASER TECHNOLOGY	4000	489	19043	0	0	0	0	0	0	0
04G MINIATURE DETECTION DEVICES & ANALYSIS METHODS	0	2979	0	0	0	0	0	0	0	0
04H ZEUS LASER ORDNANCE NEUTRALIZATION	0	3178	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

Recent advances in solid state laser and other High Energy Laser (HEL) weapons technologies may set the stage for the development of Army tactical laser weapons capability for the Objective Force. Potential HEL mission areas include counterair munitions defense and airborne electro-optical sensor countermeasures. Technical issues such as lethality; laser fluence degradation due to atmospheric effects; precision optical pointing and tracking; and effectiveness against low-cost laser countermeasures, must be resolved before any weapon system development can commence. To support the resolution of these technical issues, this project will leverage existing laser weapon programs such as the US/Israeli Tactical High Energy Laser ACTD, the USAF Airborne Laser Program, and the Department of Energy National Ignition Facility. In addition, this project will develop preliminary system designs to highlight potential sub-system/component issues attributable to technology integration. Current funding will develop a diode-pumped 15kW solid state laser breadboard by FY04. The work in this program element is consistent with the Army Directed Energy Master Plan and the Army Modernization Plan. Work in this program element is related to and fully coordinated with efforts in PE 605605A (DOD High Energy Laser Systems Test Facility) and PE 0603308A (Army Missile Defense Systems Integration) 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 US Army Space and Missile Defense Command (SMDC), in Huntsville, AL.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602307A - Advanced Weapons Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	0	993	993	0
Appropriated Value	0	6693	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	0	0	0	
c. Omnibus or Other Above Threshold Reductions	4000	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	0	-61	0	
Adjustments to Budget Years Since FY2001 PB	0	0	18050	
Current Budget Submit (FY 2002/2003 PB )	4000	6632	19043	0

Change Summary Explanation: Funding - FY 2000: a Congressional add for ZEUS (4000) was reprogrammed from procurement to RDTE. Work was performed by SMDC, Huntsville, AL.

FY2001: Congressional adds were received for Project 04G, Miniature Detection Devices Sensors and Isotope Identification (+3000), and Project 04H, Zeus Laser Ordnance neutralization (+3200). 500K for Solid State Lasers was transferred to RDTE, Defense Wide.

- (+3200) Design, fabricate, test and evaluate full-scale, integrated Zeus laser ordnance neutralization system utilizing a 1kw laser for safe and effective destruction of unexploded ordnance and surface-laid

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602307A - Advanced Weapons Technology**

mines

- (+3000) Evaluate miniature detection devices and analysis methods for lightweight power sensors and isotope identification techniques.

In FY 2002/2003 funding was increased to meet the needs for increased lethality options for Future Combat Systems (FCS) and the Objective Force through enhanced efforts in Solid State High Energy Laser Technology and Chemical High Energy Laser Technology (FY 02 +18050 and FY 03 +10242).

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>			PE NUMBER AND TITLE <b>0602307A - Advanced Weapons Technology</b>					PROJECT <b>042</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
042 HIGH ENERGY LASER TECHNOLOGY	4000	489	19043	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** Recent advances in solid state laser and other High Energy Laser (HEL) weapons technologies may set the stage for the development of Army tactical laser weapons capability for the Objective Force. Potential HEL mission areas include counterair munitions defense and airborne electro-optical sensor countermeasures. Technical issues such as lethality; laser fluence degradation due to atmospheric effects; precision optical pointing and tracking; and effectiveness against low-cost laser countermeasures, must be resolved before any weapon system development can commence. To support the resolution of these technical issues, this project will leverage existing laser weapon programs such as the US/Israeli Tactical High Energy Laser ACTD, the USAF Airborne Laser Program, and the Department of Energy National Ignition Facility. In addition, this project will develop preliminary system designs to highlight potential sub-system/component issues attributable to technology integration. Current funding will develop a diode-pumped 15kW solid-state laser breadboard by FY04. Successful progress in this 15kW effort would lead to the development of a 100kW demonstrator and this enhanced effort would be reinforced with additional resources. The work in this program element is consistent with the Army Directed Energy Master Plan and the Army Modernization Plan. Work in this program element is related to and fully coordinated with efforts in PE 605605A (DOD High Energy Laser Systems Test Facility) and PE 0603308A (Army Missile Defense Systems Integration) 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 US Army Space and Missile Defense Command (SMDC), in Huntsville, AL.

**FY 2000 Accomplishments**

- 4000 Design, fabricate, test and evaluate full-scale, integrated Zeus laser ordnance neutralization system utilizing a 1kW laser for safe and effective destruction of unexploded ordnance and surface-laid mines.
- Total 4000

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602307A - Advanced Weapons Technology**

PROJECT  
**042**

**FY 2001 Planned Program**

- 474 Identify and assess technical issues such as lethality, laser fluence degradation due to thermal blooming and atmospheric obscurants, precision optical pointing and tracking, and effectiveness against low-cost laser countermeasures.
  - 15 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 489

**FY 2002 Planned Program**

- 16043 Begin multi-year development of diode-pumped 15kW solid-state laser breadboard. This breadboard will represent the basic building block for higher power solid state lasers and demonstrate basic technology readiness. Major efforts will include:
  - Laser Diode Development: Produce diode/cooler packages to populate a full-size three-disk laser module using rack & stack technology. Reduce the production cost of laser diode/cooler integrated packages to \$5/W. Demonstrate integration of prime power at the 1kW/kg level.
  - Thermal Management: Demonstrate ability to maintain disk temperature to a delta of < 1oC across a single subscale disk. Will also demonstrate (off-line) a 3-minute cooldown system with mist cooling and a 5W/kg cooling capability.
  - Beam Control: Develop a testbed to assess and define atmospheric compensation requirements with closed-loop feedback. Based on detailed wave optic codes, the beam diameter to coherence length ratio (D/ro) estimate for propagation is 5. Using this ratio as a basis, demonstrate tilt-only atmospheric correction improvement in the Strehl ratio from 0.18 (non-corrected) to 0.28 and a tilt and focus correction improvement of 0.32.
  - Design Analysis: Determine system parameters required for an effective tactically mobile HEL weapon. Assess atmospheric propagation, system lethality, size constraints and technology maturity for various HEL technology approaches.
  - Engineering Design: Perform first-order-detailed design of a tactically mobile HEL Air Defense Weapon System to include the engineering design and analysis complete with simulation-based feasibility assessments of systems performance as a function of threat. Assess atmospheric effects and compensation, where applicable; system lethality; size constraints; life cycle costs; total system cost-per-kill; logistical burden; and technology maturity. Identify barriers to building a tactically mobile HEL system for air to ground deployment.
- 3000 Begin the evolution of the Tactical High Energy Laser system into a weaponized, smaller and mobile system capable of destroying rockets, artillery, and mortar threats. Major examples will include:
  - Design Analysis: Examine system architecture and concepts; perform technical and engineering risk reduction.
  - Lethality Assessment: Expand lethality database, confirm and expand simulations and models, test against a threat set.

Total 19043



**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602307A - Advanced Weapons Technology**

PROJECT

**042**

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602308A - Advanced Concepts and Simulation**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	32650	36181	20579	0	0	0	0	0	0	0
C90 ADVANCED DISTRIBUTED SIMULATION	13966	11486	10872	0	0	0	0	0	0	0
C99 ADVANCED CONCEPTS & TECH II (ACT II)	13911	11853	0	0	0	0	0	0	0	0
D01 PHOTONICS RESEARCH	4773	4965	0	0	0	0	0	0	0	0
D02 MODELING & SIMULATION FOR TRAINING AND DESIGN	0	7877	6994	0	0	0	0	0	0	0
D03 JOINT MODELING & SIMULATION SYSTEM (JMASS)	0	0	2713	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This program element (PE) funds modeling and simulation technology research and applies it to the development, testing and training of the Future Combat Systems and the Objective Force. It develops standards, architecture and interfaces essential to realizing the DoD/Army vision of creating a verified, validated and accredited synthetic "electronic battlefield" environment which can be used to investigate and refine new warfighting concepts, including generation 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 and training. U.S. Army Simulation Training and Instrumentation Command (STRICOM), located at Orlando, FL is responsible for Projects AC90, D02 and D03. Project AC90 develops technologies for advanced distributed interactive simulation. Work is performed by the broadest range of the nation's industrial and academic communities. Project DO2 represents a restructure from Project AC90 starting in FY01. This project enables the rapid transfer and development of simulation and training technology research results to the Army from the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. In August, 1999, ICT was designated as a University Affiliated Research Center (UARC) to leverage the entertainment and game industries in advancing the Army's modeling and simulation technology and applications. This project will ensure the transition of the results of the basic research component of the UARC, sponsored through PE 0601104A/Project J08, into the Army tech base and future Army training products. In Project D03, STRICOM will develop components for the Joint Modeling and Simulation system, which is a flexible simulation system that assists model developers, engineers, and analysts in the development of digital models, configuration and execution of simulations, and analysis of simulation results - all at the engineering and engagement levels. These programs are fully coordinated with other Army applied research programs, Defense Advanced Research Projects Agency (DARPA), Defense Modeling and Simulation Office, TRADOC and DoD Project Reliance, with oversight provided by the Joint Directors of

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602308A - Advanced Concepts and Simulation**

Laboratories. Work in these projects is related to and fully coordinated with efforts in PE 0604715A (Non-System Training Devices - Engineering Development). Project D01, Photonics Research, is a Congressionally directed project which funds research conducted at the Boston University Photonics Center. Applications include technology for night vision and imaging equipment and devices to enable communications while on the move. The cited work is consistent with the Army Science and Technology Master Plan (ASTAMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM). This program line supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	29677	30479	28172	0
Appropriated Value	29955	36479	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-776	0	0	
c. Omnibus or Other Above Threshold Reductions	-119	0	0	
d. Below Threshold Reprogramming	3749	0	0	
e. Rescissions	-159	-335	0	
Adjustments to Budget Years Since FY2001 PB	0	0	-7593	
Current Budget Submit (FY 2002/2003 PB )	32650	36144	20579	0

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602308A - Advanced Concepts and Simulation**

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for: Project D01, Photonics Research (+5000); and Project C90, for STRICOM On-line contract document management (+1000).

-(+5000) D01, Photonics Research to address Army needs in bio-agent detection, and sensitive sensors for imaging and laser sources.

FY 2002/2003 funding for Advanced Concepts and Technology II (ACT II) was terminated and realigned to higher priority efforts.

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

June 2001

<b>BUDGET ACTIVITY</b> 2 - APPLIED RESEARCH			<b>PE NUMBER AND TITLE</b> 0602308A - Advanced Concepts and Simulation					<b>PROJECT</b> C90		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
C90 ADVANCED DISTRIBUTED SIMULATION	13966	11486	10872	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This program researches and applies enabling technologies for advancing distributed interactive simulation in the synthetic environment. C90 provides the representation of the battlefield needed to support the use of modeling and simulation as an acquisition and training evaluation tool. C90 provides a 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 embedded simulation, intelligent forces representation, rapid and cost-effective generation of synthetic environments, simulation interface and linkage technologies, and complex data modeling and interchange. This system supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 980 Implemented an Advanced Tactical Engagement Simulations (A-TES) framework with simulation-intensive R&D of soldier-fired indirect fire weapons.
- 3800 Conducted in-vehicle High Level Architecture (HLA) experiments in cooperation with Tank-Automotive Research Development Engineering Center (TARDEC) using Vehicle Electronics Suite.
- 846 Implemented intelligent behavioral capabilities and substantiated significantly increased capabilities for scaleable and configurable Computer Generated Forces (CGF) representation.
- 3841 Tested and evaluated a prototype distributed architecture in the STRICOM Technology Development Center (TDC) to provide networked services for an integrated synthetic environment utilizing HLA, wireless network, and high fidelity model data compression techniques.
- 800 Prototyped dismounted soldier Virtual Environment (VE) night vision/sensor capability. Evaluated and refined Military Operations on Urbanized Terrain (MOUT) VE training methods. Tested and evaluated an advanced control system for locomotion simulator. Prototyped dismounted soldier VE voice recognition system.
- 800 Established common processes in order to evaluate a prototype infrastructure to build an integrated, interoperable, and reusable Synthetic Natural Environment (SNE).

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

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602308A - Advanced Concepts and Simulation**

PROJECT  
**C90**

**FY 2000 Accomplishments (Continued)**

- 2899 Conducted research for intelligent agents at the Institute for Creative Technologies.

Total 13966

**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 Establish an Embedded Simulation System (ESS) using a Mobile Crew Station Surrogate (MCSSL) at Ft Knox. Establish a testbed for Embedded Training for Future Combat Systems (FCS) in the areas of SNE, intelligent tutoring and robotics behavioral simulation.
- 870 Study intelligent behavioral approaches related to FCS robotics. Evaluate prototype capabilities and address technology transfer and implementation issues.
- 2028 Extend the distributed architecture to promote interoperability of Army simulation systems including Close Combat Tactical Trainer (CCTT), Warfighters' Simulation (WARSIM), and One Semi-Automated Force (OneSAF).
- 900 Prototype dismounted soldier virtual environment gesture recognition system. Evaluate effectiveness of night operations simulation.
- 1000 Test and evaluate reduced development time/cost for an interoperable SNE.
- 700 Construct Medical Simulations to evaluate an Advanced Trauma Patient Simulation (ATPS) system triage and After Action Review (AAR) to promote improved readiness for Army medics.
- 800 Prototype a web-based, distributed simulation capability to support training of Field Artillery Officers in the employment of indirect fire assets as part of a combined arms team or as a stand-alone training tool using Advanced Distributed Learning (ADL).
- 1000 The objective of this one-year Congressional special interest effort is to implement an online contract document management system for STRICOM.
- 400 Management support for Institute of Creative Technology
- 308 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 11486

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June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602308A - Advanced Concepts and Simulation**

PROJECT  
**C90**

**FY 2002 Planned Program**

- 895 Optimize results from the Hardware-in-the-Loop experiments for smaller size, better form factor, and improved interfaces with other systems.
  - 1300 Test established metrics to assess the environment development process; test methodology to assess interoperability of linked virtual, constructive, and live systems.
  - 900 Prototype Intelligent Tutoring Systems to provide student "individualized" instructional support of cognitive training tasks in the web-based environment.
  - 800 Complete prototype of the Advanced Trauma Patient Simulator (ATPS) and create an experiment to substantiate that the improved system increases core competency levels. Establish metrics to assess system functionality and the methodology to assess the system's interoperability.
  - 2277 Construct/extend the distributed simulation environment for FCS to promote improved Course of Action Analysis (COAA) and Force Projection Logistics (FPL) capabilities.
  - 1889 Construct/extend computer generated forces technology and prototype robotics simulation and training testbed for Future Combat System (FCS)
  - 1411 Construct/extend immersive simulation technology for distributed simulation networks in support of Objective Force training.
  - 1000 Modeling and Simulation for MOUT, Communication and Control (C2), and Human Behavior representation in support of Objective Force training
  - 400 Modeling and Simulation support for the Institute for Creative Technologies.
- Total 10872

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602308A - Advanced Concepts and Simulation</b>					PROJECT <b>D02</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
D02 MODELING & SIMULATION FOR TRAINING AND DESIGN	0	7877	6994	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project is a restructure from Project AC90 and enables the rapid transfer and development of simulation and training technology research results to the Army from the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. ICT was designated in August 1999 by DDR&E as a University Affiliated Research Center (UARC) to support Army training and readiness through research into simulation and training technology such as mission rehearsal, leadership development, and distance learning. ICT actively engages industry (multimedia, location-based simulation, interactive gaming) to exploit dual-use technology. ICT serves as a means for the military to learn about, and benefit from entertainment technologies, and enable their transfer into military systems. ICT works with creative talent from industry in order to adapt their concepts of story and character to increasing the degree of immersion experienced by participants in synthetic experiences, and to improving the utility of the outcomes of these experiences. In return, industry leverages the DoD sponsored research being done by the advanced Modeling and Simulation UARC. This project ensures the transition of the research into the Army tech base and future Army training products. Creating a true synthesis of creativity and technology and harnessing the capabilities of industry and the R&D community, it revolutionizes military training and mission rehearsal by making it more effective in terms of cost, time, the types of experiences that can be trained or rehearsed, and the quality of the result. It allows the United States to maintain dominance in simulation and training technologies. The US Army Simulation Training and Instrumentation Command (STRICOM) in Orlando, Florida, develops new Army training systems from the transitioned technology. STRICOM is collaborating with the Battle Command Battle Laboratory (BCBL) at Ft. Leavenworth, Kansas, which is working on the Training, Leadership Development, and Soldier Support (TLS) issues for contingency forces and operations. Funding for this program was enhanced in FY 2001 to support applied research on more effective and immersive synthetic environments. This system supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Program not funded in 2000.



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602308A - Advanced Concepts and Simulation**

PROJECT  
**D02**

**FY 2001 Planned Program**

- 7643 Develop large-scale virtual environment technology to create a photo-realistic environment, advance the emotion and speech synthesis algorithms to create more realistic virtual humans to populate the virtual environment, and develop algorithms and techniques for lighting virtual environments and objects that are later placed in the environments. Integrate all these technologies into a concept demonstration to establish areas needing additional research. These virtual worlds directly support training and mission planning and rehearsal for Army Transformation and preparing the Objective Force for future operations.
  - 234 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 7877

**FY 2002 Planned Program**

- 2994 Develop techniques and methods for integrating different sensory cues like smell and sound into virtual environments. Provide concept demonstrations to enhance the education and learning experiences possible through advanced immersive techniques. These environments will impact education and training systems for the legacy and Objective Force.
  - 4000 - Accelerate at the University of Southern California's Institute for Creative Technologies (ICT) the exploitation of products from partnership with academia and the entertainment industry, with emphasis on game based training.  
 - Accelerate at the ICT the development of mission rehearsal technologies for Stability and Support Operations (SASO).
- Total 6994

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602308A - Advanced Concepts and Simulation</b>				PROJECT <b>D03</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
D03 JOINT MODELING & SIMULATION SYSTEM (JMASS)	0	0	2713	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** STRICOM will develop Army-specific components for the Joint Modeling and Simulation System (JMASS) for use in modeling and simulation and application in advanced concepts, research and development, test and evaluation, and analysis. JMASS threat models are developed and validated by the intelligence community. DoD testers and decision makers will be able to use the same JMASS models for system evaluation and milestone decisions, as were used during system development. This will reduce the time required for milestone preparation and will increase the probability of a successful milestone decision by eliminating the inconsistent results often obtained when different models are used for development and testing. JMASS models are modular and can easily be modified to meet specific user requirements, thus reducing the need to develop new models. STRICOM will create a Synthetic Environment that supports analysis and real-time simulation. Currently there is no real-time implementation of the JMASS. Establish a real-time simulation framework using the building blocks and toolkits provided by the JMASS with its collection of defined, documented interface standards to which a model should be built. This framework uses real-time distributed standards - Institute for Electrical and Electronic Engineers (IEEE) distributed simulation standards and draft International Standards Organization (ISO) Modeling and Simulation Data Representation Standards. This flexible entity based framework supports correlated multi-sensor real-time environment allowing simulations, which can sustain acquisition; as well as the development of tactics, techniques and procedures for the Future Combat System. This system supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Program not funded in 2000

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602308A - Advanced Concepts and Simulation**

PROJECT  
**D03**

**FY 2001 Planned Program**

Program not funded in 2001

**FY 2002 Planned Program**

- 2713 Research and develop baseline for real-time simulation using JMASS models and prior basic research to ensure compatibility and interoperability for multi-sensor real-time simulations.

Total 2713

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	57684	88274	82441	0	0	0	0	0	0	0
C05 ARMOR APPLIED RESEARCH	8150	13333	15983	0	0	0	0	0	0	0
C84 AC84	0	0	983	0	0	0	0	0	0	0
H77 ADV AUTOMOTIVE TECH	29052	30811	16558	0	0	0	0	0	0	0
H91 TANK & AUTOMOTIVE TECH	20482	14729	19265	0	0	0	0	0	0	0
HH7 FUTURE COMBAT SYSTEMS - APPLIED RESEARCH	0	7681	19652	0	0	0	0	0	0	0
HH8 VOICE INTERACTIVE DEVICE	0	1982	0	0	0	0	0	0	0	0
T21 21ST CENTURY TRUCK (T21)	0	12802	10000	0	0	0	0	0	0	0
T26 HYBRID ELECTRIC HMMWV	0	6936	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The goal of this Program Element (PE) is to develop component technology to improve automotive and survivability capabilities of Army ground vehicle systems for the Objective Force. Technologies matured in this PE usually transition to PE 0603005A to demonstrate their technical feasibility and operational potential. This PE provides a portion of the Army's share of the Army/Defense Advanced Research Projects Agency (DARPA) collaborative Future Combat Systems (FCS) program. This funding supports both the FCS design and demonstration activities, and critical enabling technologies at DARPA. Army/DARPA FCS funding is identified within this PE under project HH7 and is also funded in projects 440 and 53G in PE 0603005A. To achieve the Army vision, the Army must be more strategically deployable and agile, with a smaller logistical footprint. In addition, these lighter ground vehicle systems must be more lethal, survivable and tactically mobile. Other major projects within this PE include: H91, which provides critical automotive enabling component technologies, such as active protection defeat mechanisms, that support FCS; C05, which addresses advanced, lighter armor technology for FCS and the Objective Force; and H77, which funds the National Automotive Center (NAC). The NAC leverages the large commercial investments in automotive technology research and development, and it pursues shared technology programs that focus on benefiting military ground vehicles. The PE adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles, with oversight and coordination provided by the Joint Directors of Laboratories. There is no duplication of effort within the Army, or DoD. The project is coordinated with the Marine Corps office through the Naval Surface Warfare Center; and with other ground vehicle developers within the Departments of Energy, Commerce and Transportation and the DARPA. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

Army Tank-Automotive and Armaments Command (TACOM) Tank-Automotive Research, Development and Engineering Center (TARDEC), DARPA, contractors and universities. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	54776	63589	64724	0
Appropriated Value	55249	89089	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1033	0	0	
c. Omnibus or Other Above Threshold Reductions	-159	0	0	
d. Below Threshold Reprogramming	3941	0	0	
e. Rescissions	-314	-815	0	
Adjustments to Budget Years Since FY2001 PB	0	0	17717	
Current Budget Submit (FY 2002/2003 PB )	57684	88274	82441	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for the Smart Truck Initiative (+3500) (H77), Alternative Vehicle Propulsion (+8000) (H77), the NAC Advanced Tactical Transportation Technology Initiative (+3000) (H77), the Hybrid Electric High Mobility Multipurpose Wheeled Vehicle (HMMWV) (+7000) (T26), Full Spectrum Active Protection (+2000) (H91), and Voice Instructional Device (+2000) (HH8).

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602601A - Combat Vehicle and Automotive Technology**

(+3500) (H77) This continues Congressional adds to demonstrate various advanced automotive technologies pertaining to Smart Truck. No additional funding is required to complete this project.

(+8000) (H77) This one-year Congressional add was provided to test and mature a proton exchange membrane fuel cell propulsion for line haul trucks. No additional funding is required to complete this project.

(+3000) (H77) This one-year Congressional add was provided to test and mature a solid oxide fuel cells for auxiliary power units. No additional funding is required to complete this project.

(+7000) (T26) This continues several Congressional adds to provide for maturation and testing of a hybrid electric drive High Mobility Multipurpose Wheeled Vehicle (HMMWV). No additional funding is required to complete this project.

(+2000) (H91) This is the second Congressional add to provided maturation of active protection countermeasure technology (e.g., blast fragment warhead) to be evaluated as part of Full Spectrum Active Protection System. No additional funding is required to complete this project.

(+2000) (HH8) This one-year Congressional add project will design and develop a prototype voice activated computer solution for insertion into the Smart Truck technology demonstrator. No additional funding is required to complete this project.

FY 2002: Funding was added for 21st Century Trucks program (Project T21) (+10000); funds added for light weight armor for FCS (Project C05) (+2500); funds added to develop robust active protection defeat mechanisms to protect medium weight vehicles against chemical energy, kinetic energy, and high explosive anti-tank munitions (Project H91) (+5000).

FY 2003: Funding was added for light weight armor for FCS (Project C05) (+5085).

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

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BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602601A - Combat Vehicle and Automotive Technology</b>				PROJECT <b>C05</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
C05 ARMOR APPLIED RESEARCH	8150	13333	15983	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project lays the technical foundation to solve critical armor deficiencies to transform the Army into a more deployable and survivable force. Emphasis is placed on armor technologies for FCS. In addition, this project researches and matures low-burden solutions for the protection of tactical vehicles in war and operations-other-than-war, focusing on appliqué armor for small arms and land mine protection. International cooperative research in mine blast characterization and vehicle response is also conducted within this project. Armor technologies will be researched to complement innovative, non-armor survivability techniques, such as laser and active protection, described in project AH91 within this PE. Efforts focus on the weight, space, performance, and cost for protection of combat and tactical vehicles against such threats as Kinetic Energy (KE) projectiles, explosively formed penetrators, chemical energy warheads, and blast and fragments from land mines. This project draws upon products from Army Research Laboratory programs in PE 0602618A (Ballistic Technology) and PE 0602105 (Materials), as well as innovative armors from industry. Starting in FY01, funding in the project has been increased to research significantly lighter, innovative armor solutions for FCS. This project also includes supporting work in armor materials, bringing together the collective expertise of the Department of Defense, the Department of Energy, industry and academic sources. Supporting work also includes researching and maturing of armor performance models to assess armor configurations against different threats, with sufficiently high fidelity to make their implementation in vehicles feasible and affordable. Major contractors include: SAIC, Albuquerque, NM; Southwest Research Institute, San Antonio, TX; University of Hawaii, Honolulu, HI. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

- 2818 - Investigated 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.  
- Researched and defined lightweight armor systems for protection against a spectrum of threats faced by vehicles in the less than 20 ton weight range.
  
- 3594 - Characterized the debris produced by KE and Chemical Energy (CE) threats that have been disrupted by prototype Active Protection System (APS) countermeasure warheads, to provide the foundation for the lightweight armors that will complement APS to protect combat vehicles.  
- Defined, through simulation and component testing, the structural and material requirements for light weight, integrated, multifunctional armor/structure systems.

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**C05**

**FY 2000 Accomplishments (Continued)**

- Integrated armor configurations from 0602618A/H80 and material and structure technology from 0602105A/H84 into multiple armor/structure systems for demonstration in FY 2001.

- 1796 - Completed fabrication and demonstration of armor for troop protection from blast mines while in a tactical vehicle.
- In partnership with United Kingdom (UK), developed a set of design tools to investigate unique electro-dynamic defeat, of anti-armor threats technology constructs, for combat vehicle upgrades and concepts.

Total 8208

**FY 2001 Planned Program**

- 5311 - Test the capability of armor systems with 30% greater weight efficiency than the 1996 state of the art, against horizontal KE and CE threats, and the determine the capability of these armors to withstand the threat debris from an APS countermeasure intercept.
- Investigate and test top attack armor systems to complement future APS with 30% greater weight efficiency than the 1996 state of the art.
- 4421 - Complete investigation of 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.
- Investigate armor/structure systems with 30% improved weight efficiency against medium caliber KE and CE threats for validation in FY02.
- 3240 - Integrate existing physics-based and engineering-based models and design tools to provide industry the capability to design and validate FCS armors without extensive and costly testing.
- Support and provide U.S. national leadership to an international cooperative research program for mine blast characterization under The Technical Cooperation Program (TTCP).
- Conduct safety and user assessments.
- In partnership with UK, develop a set of design tools to investigate unique electrodynamic defeat of anti-armor threat technology constructs for combat vehicle upgrades and concepts.
- 361 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 13333



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

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**C05**

**FY 2002 Planned Program**

- 6592 - Mature second generation armor systems that will be available for FCS designs to defeat medium caliber cannon, hand held infantry weapons, and residual KE behind APS debris to approach meeting a weight efficiency goal of 80 lbs/sq ft; these armor systems will provide light combat vehicles with the survivability required on the future battlefield.  
 - Investigate and test top attack armor systems to complement future APS with 30% greater weight efficiency than the 1996 state of the art.
- 4867 - Mature second generation of integrated multifunctional armor/structure systems against the heavy machine gun threat that will be available for FCS designs to approach meeting a weight efficiency goal of less than 20 lbs/sq ft.  
 - Provide armor and model data for defeat of APS residual KE, medium caliber KE and CE threats which meet APS demo weight efficiency goal of 160 lbs/sq ft.
- 4524 - Integrate existing physics-based and engineering-based models and design tools to provide industry the capability to design and validate FCS armors without extensive and costly testing.  
 - Acquire experimental data for use in existing mine survivability design codes; provide U.S. national leadership to an international cooperative research program for mine blast characterization under the TTCP.

Total 15983

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602601A - Combat Vehicle and Automotive Technology</b>					<b>PROJECT</b> <b>H77</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H77 ADV AUTOMOTIVE TECH	29052	30811	16558	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project funds the National Automotive Center (NAC), which leverages large commercial investments in automotive technology research and development and initiates shared technology programs that focus on benefiting military ground vehicle systems. The dual use technologies being developed will support the Army's wheeled vehicles legacy fleet that may comprise a substantial segment of the Future Combat Systems and the Objective Force. Improvements in the Legacy force are expected to rely heavily on dual-use technologies for advances in operational, performance and cost characteristics. 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: fuel efficiency, vehicle modernization, crew safety, maintenance, and logistics improvement and manufacturing innovation 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 the Army's Dual-Use Science and Technology (DUS&T) resources. Industry joint investment under the NAC DUS&T programs exceeds \$80M. The activities of the NAC are supported by other government agencies via a linkage created under Memoranda of Agreement. 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 (National Automotive Center). Major contractors include: FOCUS: Hope, Detroit, MI; 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; Electronic Data Systems, Troy, MI; University of Wisconsin, Madison, WI; University of Iowa, Iowa City, IA; Evans and Southerland Inc., Salt Lake City, UT; IITRI, Chicago, IL; Lockheed Martin Control Systems, Johnson City, N.Y; Ford Motor Company, Dearborn, MI; Continental Teves, Inc., Auburn Hills, MI; Sunline Services Group, Thousand Palms, CA; Ultramer Inc., Massillon, OH; Mobile Medical International, St. Johnsbury, VT; Oakland University, Rochester, MI; General Dynamics Land Systems (GDLS), Muskegon, MI; and Parametric Technologies Corp, Waltham, MA. This program supports the Objective Force transition path of the TCP.

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

June 2001

**BUDGET ACTIVITY**  
**2 - APPLIED RESEARCH**

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

**PROJECT**  
**H77**

**FY 2000 Accomplishments**

- 12191 - Researched and investigated technologies to improve fuel efficiency through engine research, hybrid-electric drive Family of Medium Tactical Vehicles (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.  
 - Performed HMMWV vehicle endurance tests with reconfigured 6.2 liter engine, performed producibility study, conducted operational & savings (O&S) cost assessment and analysis.
- 3852 - Integrated 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.
- 9640 - Performed congressionally directed program that completed the research of the diesel fuel reformer for a line-haul truck, integrated the reformer with a fuel cell engine on the current test truck, and conducted extended laboratory, track and on-road tests.  
 - Evaluated subcontractor and supplier capability and availability for integration of electronic architecture into demonstrator vehicle.  
 - Integrated and tested the optimized controls and subsystems with the diesel-fueled reformer and fuel cell power system.
- 3369 - Performed congressionally directed program that conducted market analysis of emerging vehicle electronic technologies for applicability to military wheeled vehicles.

Total 29052

**FY 2001 Planned Program**

- 5765 - Investigate and test automotive technologies in the areas of fuel efficiency, vehicle modernization, manufacturing, automotive logistics and maintenance improvement.
- 5581 - 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.
- 4682 - Complete integration plan for hardware, software, informational, and human interfaces for the selected technologies.
- 3369 - Execute one-year congressional program to demonstrate various advanced automotive technologies pertaining to Smart Truck.  
 - Produce initial and final designs for the electronic architecture and vehicle integration.
- 2888 - Execute one-year congressional program to develop Solid Oxide Fuel Cell technology.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**H77**

**FY 2001 Planned Program (Continued)**

- 7705 - Execute one-year congressional program to research and develop improved techniques for reforming JP-8 and related fuels to make hydrogen for vehicle fuel cell propulsion systems.
  - Address areas on sulfur tolerance, startup and transient response times, efficiency, and operation in hot, dry climates.
  - Initiate the development and operation of fuel cell power heavy vehicle power systems.
  - Build two additional fuel cell powered trucks for in-service evaluations, one in military environment, and one in a commercial environment.
- 821 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 30811

**FY 2002 Planned Program**

- 10556 - Investigate and test automotive technologies in the areas of fuel efficiency, vehicle modernization, manufacturing, automotive logistics and maintenance improvement.
- 4002 - 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.
- 2000 - Perform simulation based modeling and analysis in support of all areas of technology under investigation.

Total 16558

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602601A - Combat Vehicle and Automotive Technology</b>					<b>PROJECT</b> <b>H91</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H91 TANK & AUTOMOTIVE TECH	20482	14729	19265	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides innovative vehicle concepts and enabling technologies for the Objective Force and Future Combat Systems (FCS) and provide critical mobility, survivability and sustainability enhancements, required to achieve Army Transformation to the Objective Force. Program activities, such as conceptual designs, virtual prototyping, performance analyses and battlefield wargaming of ground vehicle systems, identify promising emerging technologies meeting 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 ten areas: (1) vehicle concepts; (2) mobility; (3) integrated survivability (including active protection); (4) vehicle electronics (VETRONICS) and intra-vehicle digitization; (5) advanced vehicle structures; (6) simulation/analysis; (7) military fuels and lubricants; (8) water purification technology; and (9) mechanical (as opposed to electronic) countermeasure technology and (10) gap/obstacle crossing technology. Technologies are being pursued to address advanced mobility, survivability, advanced structures, and lethality requirements of lighter, digitized, more deployable vehicles requiring less Petroleum, Oil and Lubricants (POL). Activities are closely coordinated through TRADOC's Mounted and Dismounted Battlespace Battle Labs and the Directorate of Combat Developments for Transportation; Program Executive Office for Ground Combat and Support Systems; Army Research Laboratory (ARL), and the Defense Advanced Research Projects Agency (DARPA). Virtual prototyping provides seamless sharing of databases and engineering models, allowing more rapid and efficient integration, assessment and transfer of Department of Defense and commercial vehicle technologies. Vehicle electronics are 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, damage reduction, and laser protection, complement, but do not duplicate, work performed under the armor exploratory development project (DC05) in this PE. Other government agencies include: DARPA, Arlington, VA; Army Research Laboratory, Aberdeen, MD; Red River Army Depot, Texarkana, TX. Major contractors include: Detroit Diesel Corp., Redford, MI; 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; 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; General Dynamics Land Systems Division, Sterling Heights, MI; Chang Ind., Salt Lake City, UT, & Laverne, CA; TRW, Redondo Beach, CA, Sanders Lockheed Martin, Nashua, NH; Raytheon, Danbury, Conn., New Mexico Tech., Socorro, NM, Talking Lights Company, Cambridge, MA. This program supports the Objective Force transition path of the TCP.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**H91**

**FY 2000 Accomplishments**

- 3963 - Researched innovative Future Combat Systems concepts, performed tracked vs wheeled engineering analysis, and launched an integrated data environment for FCS.  
- Established solicitation, requirements and technology capabilities for the joint Army/DARPA FCS program.  
- Completed Future Heavy Tactical Truck Concept Study. Concepts ranged from fuel cell powered trucks and trailers to fully robotic systems.  
  
- Completed investigation of immersive visualization environments by networking with the user to show the technology application for concept trade-off analysis. Determined the best use for the technology developed in the vehicle system development process.
- 5011 - Conducted field testing of the Electromechanical Suspension System (EMS) installed in a High Mobility Multipurpose Wheeled Vehicle HMMWV to evaluate active suspension under strenuous cross country conditions including steering and braking at high speeds; used the field test data to fully tune vehicle handling algorithm for safe cross country operations.  
- Investigated, tested and characterized advanced high temperature materials including ceramics, for insulation, low wear, improved durability and other key properties. Matured technology for high temperature combustion (more efficient), low heat rejection (enables smaller cooling systems) and advanced high temperature lubricants. Designed and fabricated advanced components for demonstrator engine. Completed first demonstrator engine build. (Cooperative Research Program with Japan).  
- Conducted baseline data gathering on composite bridging components through instrumented vehicle crossings on prototype composite bridging structures.  
  
- Performed analysis of marking technologies and requirements that identified criteria that will support near and far term vehicle systems and evaluated concept alternative for active marking technologies and defined architecture for integration into a mobile test bed.
- 4922 - Fabricated and evaluated optical hardware for a retrofittable wide-angle optical viewing system that can incorporate laser-limiting materials to provide laser protection for vehicle periscopes.  
- Conducted successful active protection proof of principle countermeasure and radar field evaluations based on FY99 analysis, with specific emphasis on Kinetic Energy rod defeat.  
- Evaluated concept alternatives for semi-autonomous driving using robotics technology.
- 6586 - Completed 1 year congressionally directed program to research and define FCS battle scenarios, model blue and red forces for of Combined Arms and Support Force Evaluation Model and other simulations.  
- Performed detailed technology assessments and subsystem integration studies for the FCS alternatives such as Assault, Fire Support, Command and Control, and robotics.

Total 20482

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**H91**

**FY 2001 Planned Program**

- 4570 - Jointly with DARPA, perform effectiveness, performance, cost and tradeoff analysis of innovative FCS system concepts to support the evaluation of the FCS contractor alternative concepts.
  - Mature system concepts validating the performance and cost implications of robotic vehicles in multiple roles that will be available for FCS; develop concepts for potential insertion to the Interim Brigade Combat Team and legacy force.
  - Establish and address emerging combat support requirements for tactical vehicles necessary to support the Objective Force; conduct trade-off studies and supporting performance and supportability analysis of heavy tactical vehicle concepts supporting the Objective Force; conduct simulation experiments using Army Materiel Command Research and Development Engineering Center Federation Architecture in conjunction with FCS and Objective Force efforts.
- 4468 - Complete electromechanical active suspension algorithm refinement on a HMMWV research test vehicle and investigate electromechanical active suspension application for hyper-mobility in combat vehicles that would be available for FCS; complete final 4-stroke demonstrator diesel engine build; conduct performance and durability optimization on demonstrator engine to achieve the high power density, low heat rejection and improved fuel economy goals established in the memorandum of understanding. (Cooperative Research Program with Japan.)
  - Demonstrate in laboratory increased vehicle range through fuel additives.
  - Conduct materials comparison studies of composites versus metallics and their applicability towards military bridging technologies and begin Virtual Prototyping simulations and studies of new and unique bridge launching techniques that will be available for the Objective Force.
  - Investigate, test and characterize obstacle marking and vehicle guidance systems based on FY2000 analysis; perform detailed assessments in vehicle interoperability, system deployability and cost to prepare for FY2002 test bed demonstration.
- 3795 - Integrate and evaluate Natick Research and Development Engineering Center laser protection materials into retrofittable wide-angle optical viewing system incorporating laser-limiting materials.
  - Conduct simulations to determine viable Full Spectrum Active Protection (FSAP) designs, based on preliminary proof-of-principle component demonstrations.
  - Design and fabricate improved FSAP countermeasure configured for notional delivery system and conduct field evaluations.
  - Assess armor/structure concepts developed under project DC05 to deal with adaptive threats.
- 1810 - Mature concepts for embedded unmanned system control from manned platforms to provide required capability for FCS.
  - Evaluate technique for potable water extraction from vehicle exhaust; optimize water from exhaust system components to reduce heat exchanger and demister size and weight.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**H91**

**FY 2001 Planned Program (Continued)**

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

Total 14729

**FY 2002 Planned Program**

- 5121 - Assess emerging requirements of FCS, including the role of robotics; refine Government concepts and perform analysis in support of FY03 technology readiness decision; complete independent evaluation of FCS industry team concepts through the Integrated Product Team process.  
 - Institutionalize real-time system and component level development collaboration environment for the Objective Force; these funds will be provided to and executed by the RDEC Federation.
- 4743 - Complete final 100 hour high output, low heat rejection compact 4-stroke diesel engine durability and performance demonstration to achieve the high power density, low heat rejection and improved fuel economy goals. (Cooperative Research Program with Japan.)  
 - Complete laboratory demonstration of enhanced lubricants for fuel economy and with increased oil sump temperature; evaluate candidates on second series of multi-cylinders engine tests; determine formulations that can be evaluated in field tests.  
 - Conclude materials studies of composites versus metallics; refine virtual prototype simulations of launching techniques; conduct Finite Element Modeling of weight reduction and enhancement studies.  
 - Finalize design based on FY01 detailed assessments of obstacle marking and vehicle guidance systems in the areas of vehicle interoperability, system deployability and cost; participate in Joint Area Clearance Advanced Concepts Technology Demonstrator.
- 1096 - Evaluate/validate performance levels via component structural and ballistic tests; perform structural and weight analysis of candidate FCS vehicle designs.
- 3305 - Evaluate cognitive decision aids to reduce workload on multi-mission capable systems such as FCS; mature approach/architecture for implementation of cognitive decision aids in ground systems.  
 - Construct FSAP subsystem models based on successful countermeasure demonstrations.  
 - Complete HMMWV system level design for a mounted integrated water from exhaust system; test materials/components to show concepts in a humidity concentrator to reduce the size and energy requirements of a water from air generator.
- 5000 - Develop robust active protection kill mechanisms (e.g., multi-explosively formed penetrators) to protect light-medium weight ground vehicles (i.e., FCS) against anti-armor threats, including kinetic energy penetrators and high explosive anti-tank rounds.

Total 19265



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

**June 2001**

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**H91**

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602601A - Combat Vehicle and Automotive Technology</b>				PROJECT <b>HH7</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
HH7 FUTURE COMBAT SYSTEMS - APPLIED RESEARCH	0	7681	19652	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides part of the Army's share of the Army/DARPA collaborative FCS program. The other Army funds are in project 440 and 53G of PE 0603005A. Project 53G contains the description of the joint FCS program. Funds in this project support ongoing contractual and government concept design efforts directed by DARPA, in accordance with the Memorandum of Agreement. Competing designs will be evaluated for their ability to perform combat missions across the full spectrum of operations. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

Project not funded in FY 2000.

**FY 2001 Planned Program**

- 7681 - Provide funds in support of DARPA to research and define initial force concepts as a result of tradeoff assessment process.
- Mature and evaluate innovative system concepts that reflect the force in a system of systems context; develop operational and technical models to represent the best system of systems concepts for FCS.
- Perform effectiveness, performance, cost and technology tradeoff analyses on innovative system concepts developed in support of a strategically deployable, agile, survivable and tactically mobile force for the Army. Provide information to support the development of requirements and enabling technology for FCS.
- Identify key enabling technologies to support FCS based Objective Force concept architectures.
- Perform technical and operational experimentation in support of system of systems design.

Total 7681

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**HH7**

## FY 2002 Planned Program

- 3000 - Provide funds in support of DARPA for FCS concept development.
- 16652 - Provide funds in support of DARPA for development of FCS enabling technologies (\$62436 in PE 0603005A, Project 440, also supports this effort.
  - Mature new and novel modeling and simulation techniques to support network-centric force architectures for a FCS-based Objective Force.
  - Define and apply new measures of effectiveness to evaluate Army transformation concepts.
  - Evaluate novel cooperative engagement, cooperative survivability, and command and control strategies for FCS-based tactics, techniques and procedures.
  - Initiate complete system design based upon selected concepts supporting the FCS Technology Readiness Decision in 2003.

Total 19652

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602601A - Combat Vehicle and Automotive Technology</b>				PROJECT <b>T21</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T21      21ST CENTURY TRUCK (T21)	0	12802	10000	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide a collaborative Government and commercial truck manufacturing industry research and development initiative to investigate automotive component technologies for trucks which will be much more fuel efficient, less polluting, and safer to operate. These most promising components from this research will be incorporated into test rig vehicles and tested in commercial and military operational environments. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

Project not funded in FY 2000.

**FY 2001 Planned Program**

- 7501 - Research and investigate high power density engines, lightweight engine/components, high temperature engine materials, engine coatings, coolants and cooling systems computer controlled energy management systems, electric traction motors, electric generators, high power motor controllers, integrated gate bipolar transistors, and advanced energy storage systems.
- 1800 - Integrate and test vehicle intelligence technologies that involve both information and control technology to improve fuel efficiency, driving efficiency, safety and quality of driving trucks.
- 1820 - Evaluate the use of alternative fuels to meet military requirements for fuels with high stored energy density, reduced emissions and that will facilitate the use of Solid Oxide Fuel Cell propulsion systems.
- 800 - Test and evaluate the application of current and new commercial materials technologies that result in increase payload, corrosion resistance, vehicle life cycle, durability and mobility.
- 500 - Conduct research in fuel cell technologies to include alternatives to diesel reformers and improvements in propulsion density, weight and cube of present generation fuel cells.
- 381 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 12802

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**T21**

## FY 2002 Planned Program

- 8000 Integrate, demonstrate, and test high power fuel efficient engines, lightweight engine/components, high temperature engine materials, engine coatings, coolants and cooling systems, computer controlled energy management systems, electric traction motors, electric generators, highpower motor controllers, integrated gate bipolar transistors, and advanced energy storage systems.
- 1000 - Integrate and test vehicle intelligence technologies involving information and control technology to improve fuel efficiency, driving efficiency, safety and quality of driving trucks.
- 1000 - Integrate, demonstrate, and test the use of alternative fuels to meet military requirements for fuels with high stored energy density, reduced emissions and that will facilitate the use of Solid Oxide Fuel Cell propulsion systems. This supports more stringent emissions protocols.

Total 10000

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

**June 2001**

**BUDGET ACTIVITY**  
**2 - APPLIED RESEARCH**

**PE NUMBER AND TITLE**  
**0602618A - Ballistics Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	41177	53258	61502	0	0	0	0	0	0	0
H03 ROBOTICS TECHNOLOGY	0	14344	24234	0	0	0	0	0	0	0
H75 ELECTRIC GUN TECHNOLOGY	11012	12833	5019	0	0	0	0	0	0	0
H80 BALLISTICS TECHNOLOGY	30165	26081	32249	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This program element (PE) provides ballistic technologies required for armaments and armor to support the Future Combat Systems (FCS) and the Objective Force and to allow US dominance in future conflicts across a full spectrum of threats in a global context. Project H75 focuses on pulsed power technologies for electric armaments which offer the potential to field leap-ahead capability in providing hypervelocity and hyperenergy launch well above the ability of the conventional cannon. It also includes work in hypervelocity penetrator effectiveness and electrothermal chemical (ETC) technology that will greatly increase anti-armor capabilities. Project H80 is focused on applied research in ballistics technology to enhance the lethality and survivability of future weapons. Focus areas included advanced solid propellants, launch and flight dynamics, weapons concepts for light forces, warheads and projectiles, armor and munition/target interactions. Project H03 is a restructure from Project H80 to conduct applied research for advanced autonomous mobility technology for future land combat systems of the Objective Force. Included in H03 is a total \$43.4M in funding transferred from OSD to the Army's Robotics Program from FY01 to FY05. Projects AH03 and AH80 will enable lethality and survivability technologies for the Future Combat Systems (FCS). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602618A - Ballistics Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	42017	49750	52675	0
Appropriated Value	42287	53750	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-710	0	0	
c. Omnibus or Other Above Threshold Reductions	-109	0	0	
d. Below Threshold Reprogramming	-130	0	0	
e. Rescissions	-161	-492	0	
Adjustments to Budget Years Since FY2001 PB	0	0	8827	
Current Budget Submit (FY 2002/2003 PB )	41177	53258	61502	0

Change Summary Explanation: Funding - FY 2001 Congressional add was received for Electric Gun Technology (+4000). FY02 funds (+8000) added to develop underlying sensor/perception and intelligent control technologies for near-autonomous operations.

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602618A - Ballistics Technology</b>						<b>PROJECT</b> <b>H03</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H03 ROBOTICS TECHNOLOGY	0	14344	24234	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project advances autonomous mobility technology for the Future Combat Systems (FCS) and the Objective Force. It will investigate robotics technology critical to the development of future Army systems, including unmanned elements of the FCS and crew aids for future manned systems. It provides the basis for a tri-service research consortium joining researchers from DOD, other Government agencies, industry, and academia in a concerted, collaborative effort to advance key enabling technologies. Achieving these goals will provide future land combat forces with significant new operational capabilities permitting paradigm shifts in the conduct of ground warfare, providing significantly greater survivability and deployability. Technical efforts will be focused towards advancing perception for autonomous ground mobility, intelligent vehicle control and behaviors, and human supervision of unmanned ground systems. Research will be conducted at the Army Research laboratory, other DOD laboratories and research centers, NIST, NASA and DOE research laboratories, as well as industry and academic institutions. The applied research conducted in this program will be transitioned to technology development, demonstration and materiel acquisition programs being conducted by the OSD Joint Robotics Program and each of the Services. Robotics Technology (Project H03) was previously funded in Project H80 prior to FY2001. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Project not funded in FY 2000.

**FY 2001 Planned Program**

- 2000 - Establish external research consortium involving Industry, Academia and Historically Black Colleges and Universities and Minority Institutions (HBCU/MI's) to conduct applied research on the topics of perception, intelligent control and man/machine interfaces supporting development of the Future Combat Systems.
- 11933 - Design and integrate multi-sensor perception technology required to implement baseline follower operation by unmanned ground vehicles (UGVs).  
  
- Show robotic follower operation at speeds of up to 20 MPH on-road and 10 MPH off-road.



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602618A - Ballistics Technology**

PROJECT  
**H03**

**FY 2001 Planned Program (Continued)**

- Devise machine perception technologies to enable rapid classification of a baseline set of terrain types required for high-speed autonomous mobility.
- Devise intelligent control strategies to enable UGVs to execute a basic set of military behaviors.
- Integrate perception and control technologies into a group of UGV testbed platforms. Show semi-autonomous cross-country mobility at speeds of up to 20 MPH (day), corresponding to 50% of the speed of a manned High Mobility Multipurpose Wheeled Vehicle (HMMWV), terrain dependent.
- Conduct Battle Lab Warfighting Experiment employing multiple UGVs to examine the maturity of autonomous mobility technologies.
- 411 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 14344

**FY 2002 Planned Program**

- 8000 - Execute industry/academic consortium for advanced perception, control/behavior and man-machine interface technology required for high-speed mobility (including robotic follower operations) and basic tactical behaviors common to multiple military missions.
- 8234 - Devise simulation based design tools for the development of tactical behaviors for UGVs.
- Devise and integrate mid-range perception technology and control architecture required for development of tactical behaviors.
- Integrate technology on testbed platforms and conduct engineering and troop experimentation to assess performance of perception and intelligent control algorithms.
- 8000 - Adapt and characterize sensors for autonomous navigation and mobility application in the ground combat environment with emphasis on affordability.
- Expand test-bed infrastructure to enable accelerated autonomous mobility technology development through comprehensive field data collection and experiments.
- Expand modeling and simulation infrastructure to enable accelerated autonomous mobility algorithm development and evolution.

Total 24234

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602618A - Ballistics Technology**

PROJECT  
**H75**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H75 ELECTRIC GUN TECHNOLOGY	11012	12833	5019	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project funds applied research for the Army Electromagnetic (EM) armaments technology program. To achieve the objectives of the Army Vision, future armored combat vehicles, including the Future Combat Systems (FCS), will require more lethal, yet compact main armament systems capable of defeating protection levels greatly in excess of currently experienced values. The goal of this project is to evaluate the potential of EM Armaments to field a leap-ahead capability by providing adjustable velocities, including hypervelocity, greatly above the ability of the conventional cannon. EM armaments potentially can be fully integrated with electric propulsion and electromagnetic armor systems to provide the efficient, highly mobile, and deployable armored force required by the nation. This project focuses on addressing technical barriers associated with an EM armament, in particular with pulsed power for electromagnetic (EM) launches. This project funds a new contractual effort to devise and evaluate an efficient pulsed power technology for electromagnetic (EM) launch. The goal is to provide pulsed power technology (rotating machines) with energy density of ten Joules per gram (J/g) and to identify a clear potential for growth required for future combat systems, expected to be greater than fifteen J/g. Efforts in EM pulsed power systems are conducted by Lockheed Martin - Missile and Fire Control - Dallas, TX; CEM - University of Texas - Austin, TX; Kaman Aerospace Corp. - Boston, MA; IAP - Dayton, OH; Maxwell - San Diego, CA; GE - NY; and LMCS - NY. This project funds applied research for the Army Electrothermal Chemical (ETC) gun technology program with contractual efforts by SAIC - San Diego, CA; UDLP - Minneapolis, MN; and Thiokol - Ogden, UT, in close collaboration with the Armaments Research, Development, and Engineering Center, Picatinny NJ, applying ETC technology to potential armament systems for the Future Combat System (FCS) in both medium and large caliber with the FY02 goal of increasing muzzle energy by 25%. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 8512 - Awarded new agreement for the design and evaluation of EM armament system.
  - Conducted trades for EM system including pulsed power machine, launcher, and launch package, for FY2003 demonstration of 5 J/g.
  - Designed switch array for multi-phase, multi-pole control of pulsed power machine - Sub Scale Compulsator.
  - Designed thermal management evaluation approach for rotor.
  - Conducted systems analysis of EM gun integration into future combat vehicles.
- 2500 - In close coordination with ARDEC, designed ETC ignition and propelling charge for FCS armament system.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602618A - Ballistics Technology**

PROJECT  
**H75**

## FY 2000 Accomplishments (Continued)

- Proved scalability, ballistic tailorability, and temperature compensation of ETC technology in medium caliber cannon in conjunction with contractual effort with UDLP - Minneapolis, MN.
- Initiated contractual efforts with Thiokol, Ogden UT, to devise ETC tailored propellants to provide high energy with reduced vulnerability.

Total 11012

## FY 2001 Planned Program

- 6474 - Complete design of EM armament system.
  - Conduct pulsed power component experiments showing material strength and machine preliminary design.
  - Devise initial switch array for multi-phase, multi-pole control of pulsed power machine.
  - Devise EM Gun technology component models for conducting system level simulations.
- 4000 - Conduct experiments on sub-scale EM launcher designs demonstrating robust, field-worthy attributes.
- 2000 - Show controlled step-up toward increased muzzle energy goal in medium caliber and FCS ETC cannon using tailored solid propellants.
  - Prove ETC compatibility with cased telescope cartridges.
  - In coordination with ARDEC verify reduced recoil forces using ETC and Fire-Out-of-Battery technology.
- 359 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 12833

## FY 2002 Planned Program

- 4019 - Generate advanced high power switches for converters for EM pulsed power system.
  - Design and evaluate controller for multi-phase, multi-pole operation of pulsed power machine.
  - Conduct experiments on full-scale medium caliber launcher and launch package designs demonstrating robust, field-worthy attributes.
  - Utilize EM Gun technology component models for conducting system level simulations
- 1000 - Show a 25% increase in muzzle kinetic energy with ETC for an FCS armament system.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602618A - Ballistics Technology**

PROJECT

**H75**

**FY 2002 Planned Program (Continued)**

- Identify fieldable ETC tailored propellant.

Total 5019

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602618A - Ballistics Technology**

PROJECT  
**H80**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H80 BALLISTICS TECHNOLOGY	30165	26081	32249	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The goal of this project is to provide key technologies required for armor and armaments that will enable U.S. dominance in future conflicts across a full spectrum of threats. The program supports the Army Vision by focusing on more lethal and more deployable weapons and on survivability technologies to lighten and protect Future Combat Systems (FCS) and the Objective Force. The barrier to this challenge is to insure combat overmatch and the survivability of the FCS in spite of its light weight (less than 20 tons). Specific technology thrusts include: lightweight armors and structures to defeat existing and emerging ballistic threats; Kinetic Energy (KE) Active Protection to defeat/degrade threats before they reach the combat platform; crew and component protection from ballistic shock, mine-blast, and fuel or ammunition fires; insensitive high energy propellants/munitions to increase lethality of compact weapon systems and to reduce propellant/munition vulnerability to attack; novel KE penetrator concepts to maintain/improve lethality while reducing the size/mass of the penetrator; novel multi-function warhead concepts to enable defeat of full-spectrum of targets (anti-armor, bunker, helicopter, troops); smart projectile technologies for launch, flight, and precision strike; physics-based techniques, methodologies, and models to analyze combat effectiveness of future technologies for improved ballistic lethality and survivability. Prior to FY01, this project also provided key technologies for a new class of vehicle control that will enable an unmanned land combat vehicle to intelligently follow a manned combat vehicle (technology is funded and executed in Project H03 beginning in FY01). 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 (ARDEC), Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center (TARDEC), Warren, MI; and the Aviation and Missile Research, Development and Engineering Center (AMRDEC), Huntsville, AL. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 18035 - Investigated an advanced armor system capable of defeating future medium caliber kinetic energy (KE) and shaped charge threats that is compatible with the goals of FCS.
- Performed 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.
- Evaluated, in conjunction with Army users, operational concepts employing technologies such as advanced lightweight artillery weapons and systems to enhance positional awareness; employed distributed interactive simulations incorporating these systems to improve training.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602618A - Ballistics Technology**

PROJECT

**H80****FY 2000 Accomplishments (Continued)**

- Evaluated candidate propellants produced by ARDEC and industry partners; established comprehensive database for use by ammunition designers to enhance gun lethality at reduced vulnerability.

- Evaluated performance of candidate sensor suite and kill mechanism technologies that will enable the development of KE Active Protection (KEAP).

- Exploited 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.

- 400 - Identified and successfully tested four ETC concepts (2 US and 2 German) in 120 mm during Joint Demonstration Firings conducted in Unterlues, Germany. Downselected two best concepts of the four tested for further evaluation. (NATO funds: Partner Germany) (Under Project Arrangement A-98-GE-0016).
- 5000 - Integrated sensors, perception and control algorithms on small (i.e., 1 ½ Ton class) vehicle testbeds to permit semi-autonomous cross country mobility at speeds of up to 20 MPH during daylight hours.
- 6730 - Verified and validated 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.  
Optimized 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.

Total 30165

**FY 2001 Planned Program**

- 18901 - Design and characterize innovative, lightweight armor technologies and survivability concepts to enable survivable Future Combat Systems (FCS).  
  
- Evaluate multi-disciplinary design tools that couple structural analysis, aerodynamics, and guidance, navigation, and control (GN&C) technologies for precision munitions, missiles, and rockets.  
  
- Implement selected gun propellant formulations (sample sizes) in scaled ballistic studies to show improved performance and propellant integrity with reduced vulnerability.  
  
- Evaluate and characterize selected sensor suites for threat cueing and tracking of KE penetrator in support of TARDEC-ARL-ARDEC Full Spectrum Active Protection Program; perform optimization studies to improve robustness of candidate KE counter-munition concepts.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602618A - Ballistics Technology**

PROJECT  
**H80**

**FY 2001 Planned Program (Continued)**

- Devise physics-based models and conduct experimental evaluations of novel KE/Warhead lethal mechanisms to improve FCS lethality while reducing size and mass.
  - 410 - Prove out the feasibility of future large caliber ETC guns. Evaluate selected ETC technologies based on FY00 downselect. (NATO funds: Partner Germany) (Under Project Arrangement A-98-GE-0016).
  - 6427 - Implement experimentally derived penetration and behind-armor debris algorithms to predict the lethality of U.S. medium caliber munitions against foreign tanks and personnel carriers.
  - Implement empirically based combined blast and fragment algorithms to more accurately model the effects of high explosive incendiary projectiles on the survivability of the Objective Force, including ground combat systems and helicopters.
  - 343 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 26081

**FY 2002 Planned Program**

- 25384 - Evaluate second-generation lightweight armor technologies and apply modeling and simulation tools for improved performance of FCS armors and survivability concepts.
- Apply multi-disciplinary design tools, coupled with weapons effectiveness analyses, and maturing guidance, navigation and control (GN&C) technologies (DARPA, COTS, etc) to evaluate concepts for FCS precision munitions, missiles, and rockets.
- Characterize performance of high energy/acceptable vulnerability propellant formulation (GEN II) and transition to Armament Research Development & Engineering Center for implementation in advanced multi-role armament for FCS.
- Down-select optimum KE counter-munition defeat and sensor suite configurations for transition to full-scale KEAP breadboard demonstration.
- Improve fidelity of predictive models and perform optimization studies of selected gun and missile KE/Warhead lethal mechanism concepts.
- 6865 - Characterize the ballistic-induced deformation of select composite armors and structural materials to predict the penetration and blast survivability of the FCS.
- Devise engineering-based predictions of crew acceleration and detonation/explosive reactions of stowed ammunition for Objective Force ground vehicles impacted by moderately overmatching ballistic munitions.

Total 32249

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602618A - Ballistics Technology**

PROJECT

**H80**



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

June 2001

BUDGET ACTIVITY  
2 - APPLIED RESEARCH

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

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	4542	3497	3561	0	0	0	0	0	0	0
552 SMOKE/NOVEL EFFECT MUN	3587	3497	3561	0	0	0	0	0	0	0
556 OPTICAL SPECTROSCOPY	955	0	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The goal of this Program Element (PE) is to increase personnel and platform survivability by researching and investigating enhanced smoke and obscurant technologies. The PE funds applied research in materials science and dissemination technologies to counter enemy weapon target acquisition systems and to provide the ability to degrade enemy surveillance capability. Improved multispectral obscurant materials are sought that will 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 from the visible through the microwave portion of the electromagnetic spectrum. The material and dissemination systems will be designed to be safe and environmentally acceptable. Efforts under this PE transition to Program Definition and Risk Reduction (PDRR), and System Development & Demonstration (SDD) programs. Work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This PE contains no duplication with any effort within the Military Departments. This work is performed by the U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD. This work supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	4953	3530	3550	0
Appropriated Value	4996	3530	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-111	0	0	
c. Omnibus or Other Above Threshold Reductions	-17	0	0	
d. Below Threshold Reprogramming	-300	0	0	
e. Rescissions	-26	-33	0	
Adjustments to Budget Years Since FY2001 PB	0	0	11	
Current Budget Submit (FY 2002/2003 PB )	4542	3497	3561	0

In FY00, a Congressional add was received for Optical Spectroscopy (\$1000). This project evaluated soybean oil as a substitute for the current standard visible screening smoke material.

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602622A - Chemical, Smoke and Equipment Defeating Tech</b>				PROJECT <b>552</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
552 SMOKE/NOVEL EFFECT MUN	3587	3497	3561	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** Project 552 researches and investigates smoke and obscurant technologies to increase personnel/platform survivability and to provide the ability to degrade enemy surveillance sensor capability. Improved multi-spectral smokes/obscurants are explored to enhance survivability by providing effective, affordable, and efficient screening of deployed forces from threat force surveillance sensors and effective defeat of target acquisition devices, missile guidance, and directed energy weapons, all of which can operate from the visible through the microwave portion of the electromagnetic spectrum. These systems will be designed to be safe and environmentally acceptable. Modeling and simulation will be investigated to predict performance and analyze strategic use of obscurants on the battlefield. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1370 - Conducted in-depth field evaluations of the cloud characteristics produced from obscurant propellant dissemination technologies.
- Applied propellant dissemination technologies to a smoke pot configuration. Conducted limited smoke pot field evaluations.
- Conducted assessment of methodologies and requirements analysis for Smoke/Obscurant simulation infrastructure using One Semi Automated Forces (OneSAF) model.
- Assessed delivery methods for the strategic placement of obscurants on the battlefield for Distant Smoke capabilities using modeling and simulation, along with a case study of smoke concepts.
- 2203 - Measured MilliMeter Wave (MMW) Module performance in field evaluation.
- Transitioned the MMW Module to PM Obscurant and Decon Systems for Pre-Planned Product Improvement.

Total 3573

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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

PROJECT  
**552**

**FY 2001 Planned Program**

- 2000 - Research advanced Infrared (IR) obscurants for potential use in IR smoke pots and IR projected munitions, capabilities that the Army does not have currently. The goal is to achieve 4 times the extinction performance of current materials in order to meet performance, logistics, and affordability criteria for the obscurant applications.
    - Research particle characteristics for optimal IR obscurant performance utilizing theoretical models; solicit Materials Science solutions from industry for IR obscurants; investigate foreign emissive and pyrotechnic IR and multi-spectral concepts.
  - 1420 - Down select obscurant technology for Distant Smoke System. Evaluate breadboard delivery systems.
    - Evaluate IR propellant dissemination in smoke pot configuration. Investigate additional smoke pot dissemination techniques.
    - Investigate smoke simulation in Combined Arms Tactical Trainer and OneSAF models. Conduct case studies in maneuver and urban operations.
    - Investigate novel propellant dissemination technology to provide enhanced vehicle obscuration protection in support of FCS.
    - Analyze data and document results of in-depth field evaluations of the cloud characteristics produced from obscurant propellant dissemination technologies.
  - 77 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3497

**FY 2002 Planned Program**

- 2000 -Continue investigation of advanced IR obscurants leading to improved performance for use in IR smoke pots and projected munitions. Continue to solicit new IR materials from industry and academia. Begin capitalization on foreign systems identified last year.
  - 1561 - Continue development of Distant Smoke System in preparation for demonstration in FY03.
    - Assess performance of promising smoke pot configurations.
    - Continue to investigate and upgrade simulation tools to evaluate Smoke/Obscurant systems in urban environment.
    - Continue to investigate novel propellant dissemination technology to provide enhanced vehicle obscuration protection in support of FCS.
- Total 3561

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602622A - Chemical, Smoke and Equipment  
Defeating Tech**

PROJECT

**552**

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

June 2001

<b>BUDGET ACTIVITY</b> 2 - APPLIED RESEARCH			<b>PE NUMBER AND TITLE</b> 0602623A - Joint Service Small Arms Program (JSSAP)						<b>PROJECT</b> H21	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H21 JT SVC SA PROG (JSSAP)	5069	5365	5611	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE:** This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

This Program Element (PE) researches key individual and crew-served weapon technologies that will enable the Army Transformation to the Objective Force by enhancing the fighting capabilities and survivability of dismounted battlefield personnel of the Services. Funded efforts include component technologies for: the Objective Crew-Served Weapon (OCSW); the Objective Individual Combat Weapon (OICW) system enhancements; Light Fighter Lethality; and Advanced Medium Machine Gun Technology. OCSW will provide the next generation crew-served weapon with improved combat effectiveness, including bursting munitions technology to provide 500%+ increase in probability of target incapacitation at extended range (to 2000 meters) with the capability to hit protected personnel targets in defilade (obscured or non-visible), and a 65-75% reduced weight over weapons it replaces. The OCSW is designed to replace selected M2 machine guns, MK19 grenade machine guns and M240 machine guns. The OICW System Enhancement efforts will rapidly develop lethality enhancing and cost reducing technologies for OICW. The Light Fighter Lethality effort provides smart munition based weapon system technologies that will dramatically reduce warfighter system weight (25-50% weapon weight reduction), provide near 100% lethality and maximize operational utility and survivability for the Objective Force. The Advanced Medium Machine Gun Technology effort provides technologies for a lighter, more effective and versatile replacement for current 7.62mm medium machineguns. The technology enhancement efforts of this PE will assure that the Objective Family of Small Arms (OFSA), the next generation of weapons systems, continues to overmatch the evolving threat and address the needs of the Objective Force. All Joint Service Small Arms Program (JSSAP) efforts are based upon the Joint Service Small Arms Master Plan (JSSAMP), Mission Needs Statements and Operational Requirements Documents of the Services. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program is primarily managed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey. Work in this PE is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology), and PE 0603607A (Joint Service Small Arms Program). Transition paths have been established in coordination with Product Manager (PM) Small Arms, USMC Director Ground Weapons and US Special Operations Command (SOCOM). This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3388 Researched and investigated robust, alternative OCSW fuze design for enhanced reliability and sustainability.
- 800 Conducted micro electro-mechanical systems (MEMS) based safe and arming device design activities for OICW System Enhancement for potential reduced fuze cost, weight and volume.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602623A - Joint Service Small Arms Program  
(JSSAP)**

PROJECT

**H21**

## FY 2000 Accomplishments (Continued)

- 881 Completed preliminary error budget and feasibility analysis for Light Fighter Lethality smart munition program.

Total 5069

## FY 2001 Planned Program

- 2811 Complete research and investigation into airburst, point-detonation and self-destruct functions for OCSW fuze; conduct firing demonstration tests of fully integrated OCSW fuze from 800 out to 2000 meters; build OCSW full solution fire control test hardware; research and investigate OCSW thermal module capability, leveraging OICW and other applicable technologies, leading to Early Operational Assessment.
- 1415 Test and evaluate breadboard MEMS safe and arming design employing Micro Energetic Initiation (MEI) for OICW System Enhancement to confirm feasibility of reduced fuze cost, weight and volume in preparation for technology insertion to OICW development.
- 997 Conceptualize preliminary individual system designs addressing substantial lethality increases for Light Fighter Lethality.
- 142 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5365

## FY 2002 Planned Program

- 2216 Conduct Early Operational Assessment/User testing of OCSW.
- 3395 Complete design and verification of Light Fighter Lethality critical sub-system designs through constructive simulation, individual and force on force empirical performance, leading to final design selection and fabrication of test hardware.

Total 5611

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602623A - Joint Service Small Arms Program  
 (JSSAP)**

PROJECT  
**H21**

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	5161	5415	5589	0
Appropriated Value	5187	5415	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-92	0	0	0
c. Omnibus or Other Above Threshold Reduction	-14	0	0	0
d. Below Threshold Reprogramming	0	0	0	0
e. Rescissions	-12	-50	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	22	0
Current Budget Submit (FY 2002/2003 PB )	5069	5365	5611	0



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

June 2001

BUDGET ACTIVITY  
2 - APPLIED RESEARCH

PE NUMBER AND TITLE  
0602624A - Weapons and Munitions Technology

COST (In Thousands)	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cost	35718	47817	35549	0	0	0	0	0	0	0
H18 ARTY & CBT SPT TECH	14348	12117	11997	0	0	0	0	0	0	0
H19 CLOSE COMBAT WEAPONRY	10910	17854	10344	0	0	0	0	0	0	0
H1A WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	0	2972	0	0	0	0	0	0	0	0
H28 MUNITIONS TECHNOLOGY	10460	14874	13208	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) researches improved weapon and munition technologies to enable combat overmatch for the Objective Force. Efforts are focused on meeting requirements of the Future Combat Systems (FCS). This PE funds applied research, which will result in increased system lethality and survivability with the potential of better affordability, lower weight and reduced size. Specific projects within the PE include: the FCS Multi-Role Armament and Ammunition and associated enabling technologies; advanced sensors for smart munitions; agile target effects systems for the battlefield; and the Responsive Accurate Mission Module (RAMM). The FCS Multi-Role Armament is designed to exceed the lethality of the Abrams main battle tank with a 105mm cannon for FCS. It uses advanced materials, novel recoil, and Electrothermal-Chemical (ETC) propulsion to overcome the challenges of creating a smaller, lighter weapon that has lethality equaling or exceeding a 120mm cannon. The corresponding FCS Multi-Role Ammunition will culminate in a three-cartridge suite that provides overwhelming lethality to ranges up to 50 km, with increased weapon delivery accuracy. Specific efforts in explosives, propellants, fuzing, and warhead technology support the ammunition suite. Advanced Sensors for Smart Munitions will enhance current smart sensors for use in the ammunition suite. RAMM provides technologies for an advanced mortar for FCS manned or tele-operated ground vehicles. The PE 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); advanced armament fire control, and decision aids and software architecture; advanced laser radar/infrared (LADAR/IR) sensor technology to enhance performance of smart munitions, technology advances in acoustic sensors and anti-armor and anti-personnel area denial systems, advanced wear and erosion resistant barrel coatings to increase service life and provide for environmentally friendly barrel coating process, thermal management of high performance, high rate of fire, large caliber guns, as well as ways to make artillery systems more flexible and deployable through range extension and weight reduction technologies and smart materials to improve accuracy and reduce operational and support (O&S) costs. The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. The U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey primarily manages this program. Work in this PE is related to, and fully coordinated, with efforts in PE 0602618A (Ballistics Technology) and PE 0602623A (Joint Service Small Arms Program (JSSAP)), and its technologies typically

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602624A - Weapons and Munitions Technology**

transition to PE 0603004A (Weapons and Munitions Advanced Technology) and PE 0603802A (Weapons and Munitions Advanced Development).

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	36521	33761	34654	0
Appropriated Value	36687	48261	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR/STTR	-503	0	0	
c. Omnibus or Other Above Threshold Reductions	-78	0	0	
d. Below Threshold Reprogramming	-300	0	0	
e. Rescissions	-88	-444	0	
Adjustments to Budget Years Since FY2001 PB	0	0	895	
Current Budget Submit (FY 2002/2003 PB )	35718	47817	35549	0

Change Summary Explanation: Funding - FY2001: Congressional adds were received for Multi-Role FCS Armaments (+4000), Single Crystal Tungsten Alloy Penetrators (+4500), Low Cost Correction Technology for Conventional Ammunition and Rockets (+3000) and Weapons and Munitions Technology Program Initiative (+3000).

Note: The Congressional add for Weapons and Munitions Technology Program Initiatives was originally in Project H28. It was moved to Project H1A for

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602624A - Weapons and Munitions Technology**

the President's Budget submit.

FY 2003: Funds realigned to support higher priority activities in 0603004A.

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>			PE NUMBER AND TITLE <b>0602624A - Weapons and Munitions Technology</b>						PROJECT <b>H18</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H18 ARTY & CBT SPT TECH	14348	12117	11997	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project focuses on applied research of technology for multi-role cannon, mortar weapon, smart cargo projectile, and fire control and combat support systems in support of FCS and the Objective Force. Specific efforts include FCS Multi-Role Armament and Ammunition; RAMM; Distributed Interactive Fire Mission (DIFM); QuickLook; Advanced Sensors for Smart Munitions; Advanced Acoustic/Seismic Systems; and Extended Range Mortar Cartridge. Recoil management and lightweight materials technologies are being investigated to create a more lethal, lightweight FCS Multi-Role Armament, utilizing ETC propulsion. The objective of the system is to provide multi-mission lethality suitable for a FCS that is air transportable in a C-130 aircraft. Also being pursued is the corresponding FCS Multi-Role Ammunition suite, which includes technologies for achieving both revolutionary fire support lethality and precision point target defeat at extended ranges in lighter and smaller configurations. The RAMM lightweight mortar concept will be matured suitable for insertion into FCS. Development of the DIFM software supports the FCS multi-mission fire control systems. This software will enable groups of fighting vehicles and attack helicopters 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 loitering munition that flies out to a maximum range of 50 km. and acquires and transmits targeting information (i.e., video, Global Positioning System (GPS)) back to the tactical operations center via a wireless link. Advanced acoustic sensors will be investigated which will provide non-line of sight target queuing for a variety of weapons platforms. 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 the development and evaluation of advanced area denial concepts as an FCS countermobility alternative to current anti-vehicle/anti-personnel mining techniques. Technologies for reducing artillery target location error and providing real time targeting and battle damage assessment data to fire direction centers are also being matured to support information dominance strategies for FCS. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602624A - Weapons and Munitions Technology**

PROJECT

**H18**

## FY 2000 Accomplishments

- 4600 Fabricated hardware and conducted preliminary tower flight tests to validate common aperture LADAR/IR sensor performance against low observable targets; fabricated prototype sensor hardware for gun-hardening experiments; conducted field test of prototype area denial hardware; evaluated weapons system and sensor performance; investigated alternative delivery and recovery methods; validated virtual simulations through hardware designs in support of FCS Multi-Role Armament.
- 980 Completed one-year Congressionally directed program in electrorheological (ER) fluid research that included fluid characterization software control methodology, material and structures modeling, and power supply design.
- 4200 Extended the fire mission and movement planning decision aid to a fully Technical Architecture compliant suite of decision aid components to support brigade combat team fires, sustainment, situational awareness and mission rehearsal requirements; established a baseline decision aids application software component reuse library and link with specification data library to support follow-on software component factory technology; performed DIFM domain analysis; initiated development of multi-shooter vs. multi-target algorithms; developed data acquisition methodology and design, and assessed the noise cancellation programs for Striker (High Mobility Multipurpose Wheeled Vehicle (HMMWV) platform); developed acoustic/seismic propagation models and relate performance to potential gains in cost and operational effectiveness of a sensor network.
- 3588 Fabricated QuickLook artillery-fired loitering munition system hardware components and performed sub-system testing, completed 3-D modeling of selected retrofit obturator candidates, and conducted testing of improved obturator band designs.
- 980 Completed one year Congressionally directed program to conduct Extended Range Mortar rocket motor static testing; updated interior and exterior ballistic models; conducted composite motor and fin assembly structural integrity test; conducted live-fire mass simulated flat-fire test.

Total 14348

## FY 2001 Planned Program

- 4531 Conduct system trade-off studies, fabricate sensor hardware and perform captive flight tests on alternate sensor designs with a common aperture LADAR/IR transducer for detection of low observable; further identify and investigate critical technologies; update and mature models; validate virtual simulations for stability, precision and accuracy; pursue evaluation of ER recoil management, isogrids and load out of battery technologies in support of FCS Multi-Role Armament; perform a system concept analysis of the RAMM lightweight mortar design for integration into a FCS platform or the Robotic Follower.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602624A - Weapons and Munitions Technology**

PROJECT

**H18**

## FY 2001 Planned Program (Continued)

- 3154 Complete implementation and Depth and Simultaneous Attack Battle Lab concept evaluation of an architecture-based software component factory process for rapid generation of embedded fire mission application software; Complete DIFM multi-shooter algorithms maturation; analyze and optimize the algorithms in a DIFM dedicated Modular Semi-Automated Forces (ModSAF) emulation environment; characterize multi-shooter algorithm performance; collect acoustic signatures of Multiple Launch Rocket System (MLRS), cruise missiles and mortars to expand detection data base capability; evaluate modeling for target location and tracking capabilities using non-real time data and assess improvements in operational effectiveness; pursue investigation of advanced detection, classification and tracking algorithms for advanced acoustic/seismic sensors.
- 4198 Integrate QuickLook system components and perform integrated captive flight test; exhibit improved cannon wear life (Crusader) in wear testing; verification of design improvements for stockpiled ammunition; fabricate prototype hardware and conduct limited short range flight test of the ERMIC; conduct review of mission requirements; conduct concept analysis, design trades and preliminary concept design of a smart cargo projectile for FCS Multi-Role cannon.
- 234 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 12117

## FY 2002 Planned Program

- 6474 Conclude system tradeoff studies and sensor suite packaging analysis; finalize design and begin fabrication of tactical sensor hardware for smart munitions; complete virtual model, design and fabrication of lightweight cannon system components for verification of key technologies and integration into a turreted armament demonstrator for FCS; finalize the hardware design of the RAMM mortar system and autoloader/magazine.
- 2279 Evaluate integrated acoustic cues on Strikers for AN/TPQ-36/37 (Fire Finder radar) and transmit detection messages to the fire director center; incorporate advanced detection, classification and tracking algorithms and software into acoustic sensor testbeds and validate the modeling predictions with sensor improvements.
- 3244 Conduct an evaluation of the QuickLook system detecting and locating targets in real-time using battlefield imagery and GPS coordinates; prove concept effectiveness for the smart cargo projectile; perform aeroballistic simulations and in-flight update analyses, and conduct sub-scale wind tunnel test of airframe.

Total 11997

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>			PE NUMBER AND TITLE <b>0602624A - Weapons and Munitions Technology</b>						PROJECT <b>H19</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H19 CLOSE COMBAT WEAPONRY	10910	17854	10344	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project focuses on applied research of technology for maneuver and fire support cannon armament systems in support of FCS and the Objective Force. The project funds research in technologies that will result in significantly more lethality with more accurate delivery, significantly reducing logistics footprint while reducing life cycle costs for ground and air combat platforms. This project provides opportunities for longer range, more accurate and more lethal cannon systems for armored vehicles to include enabling technologies to support FCS. Principal efforts support the ammunition suite for the FCS Multi-Role Armament and Ammunition. Also included in this project is the Tank Extended Range Munition (TERM) for rapid extended range defeat of high value targets out to 8km+ expanding the maneuver commander's battle area 7-fold. This project funds modeling and simulation of advanced armament systems leading to application for FCS. Cannon design technologies include: recoil mitigation techniques for use of large caliber cannons on lightweight (less than 20 ton) vehicles and novel chamber configuration leading to overall compact armament system configurations. Advanced barrel coating technology utilizing cylindrical magnetron sputtering (CMS) of refractory alloys is being pursued to provide extended barrel life for tanks, artillery, and FCS cannon systems in addition to providing an environmentally friendly process as a future replacement for chrome plating. This PE will develop advanced multi-mode fuzing technologies to include lower cost self-destruct technologies for submunitions, which will reduce unexploded ordnance on the battlefield and low cost electronic safe and arm devices for single and future multi-mode warheads. The project also develops extended range munitions and alternative defeat mechanisms of advanced armor systems for FCS. The approach will be to develop both the hardware and analytical tools necessary to assess system performance, identify problem areas and to develop solutions. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

- 1473 Completed CMS process to apply tantalum cannon bore coatings to test coupons.
- 2256 Conducted simulation of existing and conceptual target defeat techniques (i.e., Institute for Advanced Technology (IAT), University of Texas; Armament Research Development and Engineer Center (ARDEC); and Army Research Laboratory (ARL)) for medium caliber applications.
- 2640 Analyzed simulated and selected lethality package of advanced propulsion system for FCS; completed conceptual design of a lightweight, low recoil launcher (both 60% less than 120mm M256); developed a notional concept for improved automation of weapon platforms.
- 2626 Established target set vulnerabilities for three agile target effects systems: dazzler munition using an acoustic/light source to render sensors ineffective for a limited time, a pulsed laser generator for Unmanned Aerial Vehicles (UAV) and sensor suppression and a flat panel multi-mega/gigawatt generator demonstrating neutralization of electronic/communications equipment.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602624A - Weapons and Munitions Technology**

PROJECT

**H19**

## FY 2000 Accomplishments (Continued)

- 737 Matured enhanced target defeat for medium caliber systems exploiting emerging technologies in composite sabots, novel penetrators, propulsion and bursting munitions.
- 1178 Matured lower cost self-destruct fuze technologies for application to Dual Purpose Improved Conventional Munitions, for reduction of unexploded ordnance on the battlefield.

Total 10910

## FY 2001 Planned Program

- 1467 Complete first phase of CMS process to apply tantalum cannon bore coatings to full-length medium (25mm) and full length large (120mm) caliber gun barrels; conduct firing tests and complete correlation of results to analytical modeling; transition CMS process to industry (for medium caliber applications) and to on-going Manufacturing Technology Objective (MTO) for large caliber scale-up for application to tank, artillery, Naval Fire Support, and FCS.
- 1894 Complete testing to characterize combined directed energy sources effects on threat targets; complete detailed design of Agile Target Effects weapon system for tactical range FCS secondary armament application against sensors and UAVs.
- 4384 Complete fabrication of lightweight/low impulse launcher for FCS. Complete recoil mitigation technology demonstration of 50% reduction in recoil force; complete detailed design of lightweight/low impulse launcher for FCS Multi-Role Cannon System; determine feasibility of propulsion and launch system to launch a surrogate family of munitions at desired velocities in sub-scale firing; establish best technical approaches for Multi-Role Cannon Munition development.
- 2145 Complete electronic Safe and Arm fuzing design for Multi-Mode Warhead for missiles and smart munitions FCS application; complete concept design for advanced kinetic energy (KE) Munition configuration for defeat of advanced armors to 4km.
- 700 Mature enhanced target defeat mechanism for light armor targets using novel penetrators for increased penetration and behind armor effects.
- 2885 The purpose of this one year Congressional add is to conduct component demonstrations of technologies (sensors, diversion thrusters, etc.) providing significantly lower cost course correction of conventional direct fire ammunition eliminating most system accuracy errors for ground/air platform.
- 3954 The objective of this one year Congressional add is to validate increased armor penetration of co-linear Explosively Formed Penetrators (EFP) warhead concepts.
- 425 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 17854



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602624A - Weapons and Munitions Technology**

PROJECT  
**H19**

## FY 2002 Planned Program

- 5432 Complete fabrication of lightweight, low impulse Multi-Role Cannon for FCS and conduct non-firing functional demonstration.
- 500 Complete medium caliber novel KE penetrator target effects evaluation and downselect to best technical approach.
- 1740 Fabricate Agile Target Effects Weapon System directed energy sources for FCS secondary armament ground/air vehicle sensor personnel, unmanned air vehicle defeat.
- 2672 Validate FCS KE Munition launch package (novel penetrator with composite sabot) function from FCS ammo configuration; conduct electronic safe and arm fuzing initiation accuracy for multi-point detonations.

Total 10344

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602624A - Weapons and Munitions Technology</b>				PROJECT <b>H28</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H28 MUNITIONS TECHNOLOGY	10460	14874	13208	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This program advances the state of the art of enabling technologies supporting the Future Combat Systems (FCS) and the Objective Force. Specific efforts include warheads (both shaped charge (SC) and explosively formed penetrator (EFP)), high energy explosives, large-caliber gun propellants with barrel wear reducing additives, insensitive munitions (IM), energetics, advanced materials/processes for warheads and techniques/processes to address material corrosion. Advances in warhead design, initiation techniques, and material technology will produce smaller, lighter, more effective, multi-role warheads having advanced warhead liners to efficiently defeat existing and projected targets. Achieving increased lethality is vital as the Army strives for smaller and lighter weapon systems with smaller and lighter armaments. High energy, high-density explosives are needed to increase lethality and optimize design performance. New improved energetic materials have numerous transition opportunities for weapon system upgrades and FCS. Developmental high-impetus propellant formulations optimized for ETC initiation offer increased muzzle kinetic energy, precision ignition and unmatched repeatability. The integrated propellant and explosive insensitive munition (IM) efforts contained in this project will also increase the battlefield survivability of land combat systems and enhance overall safety at manufacturing plants, storage depots, and during air and sea transport. Analysis and development of Multiple-EFP warheads support the Army's Full Spectrum Active Protection (FSAP/APS) System research and development performed by the Tank Automotive and Armaments Command's Tank Automotive Research Development and Engineering Center (TACOM-TARDEC) under Program Element (PE) 0603005A. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

- 2607 Manufactured laboratory scale quantities of next generation, more powerful explosives and conducted sensitivity tests and evaluations, which showed excellent energy increases.
- 4053 Tested combined anti-armor/anti-bunker warheads, which showed acceptable performance.
- 2000 Formulated, fabricated and tested CL-20 based advanced propellant formulations with impressive energy increases.
- 1800 Designed, fabricated and successfully tested two multiple EFP warhead concepts for evaluation in the Full Spectrum Active Protection (FSAP) System program (PE 0603005A).

Total 10460

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602624A - Weapons and Munitions Technology**

PROJECT  
**H28**

**FY 2001 Planned Program**

- 2389 Fabricate two high-energy and high-blast explosive candidate formulations to optimize FCS multi-purpose warhead.
- 4091 Optimize the Compact SC warhead concept design for a shorter/lighter munition. Optimize the collinear EFP warhead prototype for enhanced performance.
- 1920 Mature ETC Generation II propellant formulations for FCS ETC applications. Initiate charge designs for the FCS Cased-Telescoped cartridge configuration and propulsion performance test and evaluation in scaled (30mm) and large caliber (105mm) test beds.
- 1800 Conduct dynamic testing of modified multiple EFP warhead designs against slow-moving chemical energy (CE) and fast-moving KE threats as the kill mechanism for APS system applications.
- 4326 The purpose of this one year Congressional add is to evaluate the viability and affordability of single crystal tungsten alloy material as a KE penetrator. Validate ballistic performance comparable to depleted uranium (DU) along with a viable manufacturing process.
- 348 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 14874

**FY 2002 Planned Program**

- 2232 Select, fabricate and deliver high energy and high blast insensitive explosive formulations for FCS multi-purpose warhead concept testing. Continue formulation insensitivity improvements and testing.
- 4696 Conduct laboratory demonstration of the multi-purpose SC warhead and the maturing Collinear EFP warhead concepts.
- 1595 Prove feasibility of Generation II ETC gun propellant for FCS cartridge applications providing a 25% increase in performance.
- 1685 Prove feasibility of an enhanced multiple EFP warhead for APS applications against both CE and KE threats with the goal of producing zero residual penetration (i.e., penetration potential remaining after active protection system intercept penetration on target).
- 3000 Conduct laboratory demonstrations of revolutionary Generation II EFP and Compact SC warhead designs for FCS multi-role ammo suite and common missile; demonstrate greater than 3 times penetration increase in reduced size warhead; demonstrate Compact SC size reduction by 1/2 while maintaining penetration capability.

Total 13208

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602705A - Electronics and Electronic Devices**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	35275	40891	27819	0	0	0	0	0	0	0
H11 BATTERY/IND POWER TECH	12111	21229	4492	0	0	0	0	0	0	0
H94 ELEC & ELECTRONIC DEV	23164	19662	23327	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The work under this program element provides enabling capabilities for the Objective Force by researching and investigating technologies to perform precision deep fires against critical mobile and fixed targets, to provide exceptional all-weather, day or night, theater air defense against advanced enemy missiles and aircraft, and to provide electronic components, power components, and low-cost, lightweight, high-energy density power sources for communications, target acquisition, and miniaturized displays, for applications such as the Future Combat Systems (FCS) and soldier systems. This program consists of research in the physical sciences essential to all land combat systems that contain electronics, photonics, magnetic materials, ferroelectrics, microwave and millimeter-wave components, batteries, electromechanical systems (engine generator sets) and fuel cells. Supported systems include FCS, soldier systems, autonomous missile systems, advanced land combat vehicles, smart anti-tank munitions, electric weapons, secure jam-resistant communications, automatic target recognition (ATR), foliage-penetrating radar, combat identification, and digitizing of the battlefield. This program supports the in-house applied research effort at a single Army site, which serves as both the center for display technology and the center for frequency control and timing for the Army, Navy, Air Force, and Ballistic Missile Defense Organization. It supports all of the science and technology thrust areas that employ electronic and portable power-source technology. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory and the Army Communications and Electronics Research Development and Engineering Center Fort Monmouth NJ.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602705A - Electronics and Electronic Devices**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	36812	23869	27504	0
Appropriated Value	37096	41269	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-537	0	0	
c. Omnibus or Other Above Threshold Adjustments	-83	0	0	
d. Below Threshold Reprogramming	-1000	0	0	
e. Rescissions	-201	-378	0	
Adjustments to Budget Years Since FY2001 PB	0	0	315	
Current Budget Submit (FY 2002/2003 PB )	35275	40891	27819	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received in: Project H11 for Logistics Fuel Reformer Technology (+2000), AA Zinc Air Battery for Military Applications (+1900), Improved High Rate Alkaline Cell (+1200), Rechargeable Cylindrical Cell Systems (+1600), Low Cost Reusable Alkaline Manganese-Zinc (+500), Phase III of Intell Power Control for Sheltered Systems and Vehicles (+2800), Extrusion of Polymer Electrolytes and Polymer Multilaminate Materials (+2000), Lithium Carbon Monofluoride Coin Cell (+900), AA Zinc Air Battery Production (+2000), Portable Hybrid Electric Power Research (+1500) and Polymer Extrusion (+1000).

FY 2003: Funds were realigned to higher priority activities in support of the Army Transformation.

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602705A - Electronics and Electronic Devices</b>					<b>PROJECT</b> <b>H11</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H11 BATTERY/IND POWER TECH	12111	21229	4492	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides applied research in the application of the physical sciences of energy conversion, electrochemistry, electronics, power management, and signature suppression as they apply to improving existing systems and enabling newer, more advanced battery (primary and rechargeable), fuel cell, thermoelectric, hybrid, and electromechanical (including engines and permanent magnet alternators) technologies for the Objective Force. This project investigates small, low-cost, environmentally compatible, lightweight, high energy density sources of power for communications, target acquisition, miniaturized displays, silent watch, combat service support applications, and future soldier systems. These technologies support reduced acquisition costs, and reduced operation and support costs. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 935 - Designed lithium-ion polymer electrolyte (dry cell) rechargeable battery that provides higher safety and higher capacity than wet cell batteries for Command, Control, Communication, Computer, Intelligence, Electronic Warfare and Sensors (C4IEWS) training applications; designed and tested universal smart charging cables for charging complete family of military rechargeable batteries used for C4IEWS applications; showed proof-of-concept rechargeable vest battery for the Multiple Integrated Laser Engagement Simulation (MILES) 2000.
- 700 - Completed power electronics design for the next generation family of engine driven generator power systems; installed power on-the-move system in the drive train of a tactical vehicle and performed tests to characterize electrical performance.
- 1319 - Integrated and exhibited battery/battery hybrid; assessed approaches to kinetic active and passive power generation; tested components researched by ARL/DARPA for system design of a thermophotovoltaic (TPV) power source and upgraded design; designed a hybrid fuel cell for soldier systems.
- 1020 - Generated system level design tools for integration to provide a common low power and power management design environment.
- 135 - Established power source and identified power savings technologies for an uncooled infrared (IR) sensor.
- 958 - Achieved objectives of this one-year Congressional add: evaluated low cost, improved rate capable alkaline cells for use in sensor, surveillance, and monitoring applications.

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

June 2001

BUDGET ACTIVITY

2 - APPLIED RESEARCH

PE NUMBER AND TITLE

0602705A - Electronics and Electronic Devices

PROJECT

H11

## FY 2000 Accomplishments (Continued)

- 1341 - Achieved objectives of this one-year Congressional add: delivered, tested, and evaluated prototype reusable alkaline manganese-zinc batteries with improved power capability and cycle life for C4IEWS equipment.
- 575 - Achieved objectives of this one-year Congressional add: designed, matured, fabricated, and delivered prototype rechargeable lithium ion coin cells for safety and performance evaluations.
- 384 - Achieved objectives of this one-year Congressional add: designed, matured, and fabricated initial prototype lithium carbon monofluoride cells to characterize performance, safety, and feasibility for use in batteries.
- 384 - Achieved objectives of this one-year Congressional add: demonstrated improved rate capability, high energy "AA" zinc-air cells for use in Forward Area charger applications.
- 2875 - Achieved objectives of this one-year Congressional add: evolved the micro-channel reactor and engineered catalyst technology required to reform diesel fuel/JP8 into Hydrogen suitable for use in small (soldier portable) and medium sized fuel cell systems; matured, fabricated, and tested laboratory prototypes of critical reformer components.
- 1437 - Achieved objectives of this one-year Congressional add: modeled, matured and fabricated prototype hybrid power sources and components.

Total 12063

## FY 2001 Planned Program

- 874 - Establish the most cost effective, safe, high performance primary battery with greater than 300 watt-hours per kilogram; complete applied research of a high energy rechargeable lithium-ion battery with non-flammable electrolyte for C4IEWS applications; complete research and test of manpack metal-air battery powered recharging system with universal smart charging cable for light infantry C4IEWS equipment.
- 730 - Complete integration of power components/subassemblies in a 5 kilowatt engine driven generator system design; implement tests to ensure proper operation of power electronics subsystems; integrate the power electronics subsystem into a power-on-the-move tactical vehicle.
- 1286 - Optimize battery/battery hybrid for size, weight, and cost; design and build kinetic energy harvesting system for charging soldier system batteries; design efficient 500 watt TPV system for a recharger and soldier support applications; test and demonstrate hydride fuel cell model for soldier system.
- 840 - Evolve design tools to support low power/power management, system design and system improvement for Land Warrior.
- 144 - Integrate model power source for an uncooled infrared sensor into a 3 pound weapon sight prototype.

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

June 2001

**BUDGET ACTIVITY**  
**2 - APPLIED RESEARCH**

**PE NUMBER AND TITLE**  
**0602705A - Electronics and Electronic Devices**

**PROJECT**  
**H11**

**FY 2001 Planned Program (Continued)**

- 1444 - The objective of this one-year Congressional add for Portable Hybrid Electric Power Research and Polymer Extrusion is to mature a fuel cell/battery hybrid power source.
  - 1925 - The objective of this one-year Congressional add for AA Zinc Air Battery Production is to mature a low cost primary battery for forward area recharging.
  - 1155 - The objective of this one-year Congressional add for Improved High Rate Alkaline Cell is to mature high rate, low cost AA, D cells for night vision devices.
  - 866 - The objective of this one-year Congressional add for Lithium Carbon Monofluoride Coin Cell is to mature a primary battery for memory backup/extended power.
  - 1540 - The objective of this one-year Congressional add for Rechargeable Cylindrical Cell Systems is to mature lithium ion cells for soldier systems.
  - 481 - The objective of this one-year Congressional add for Low Cost Reusable Alkaline Manganese-Zinc is to mature low cost rechargeable batteries for training.
  - 1829 - The objective of this one-year Congressional add for AA Zinc Air Battery for Military Applications is to mature high speed fabrication techniques for zinc-air batteries.
  - 962 - The objective of this one-year Congressional add for Portable Hybrid Electric Power Research and Polymer Extrusion is to mature extrusion technologies for polymer electrolytes.
  - 1925 - The objective of this one-year Congressional add for Extrusion of Polymer Electrolytes and Polymer Multilaminate Materials is to mature extrusion technologies for polymer electrolytes and polymer multilaminate materials.
  - 1925 - The objective of this one-year Congressional add for Logistics Fuel Reformer Technology is to mature a logistics fuel reformer for portable fuel cells.
  - 2694 - The objective of this one-year Congressional add for Phase III of Intelligent Power Control for Sheltered Systems and Vehicles is to mature a power management/load leveling system for shelters.
  - 609 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 21229



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602705A - Electronics and Electronic Devices**

PROJECT  
**H11**

## FY 2002 Planned Program

- 1261 - Test, in the field, a forward area battery charging system comprised of a high energy metal-air battery and smart charging cables.
  - 795 - Test, in the field, a scalable power electronics package in a five kilowatt engine generator set; test, in the laboratory, power on-the-move capabilities.
  - 1454 - Test, in the field, a battery/battery hybrid; test, in the field, a kinetic energy harvesting system; develop components for a 500 watt TPV prototype.
  - 982 - Test and show the initial low power design tool for reduced power consumption in soldier systems.
- Total 4492

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602705A - Electronics and Electronic Devices</b>					<b>PROJECT</b> <b>H94</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H94 ELEC & ELECTRONIC DEV	23164	19662	23327	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports applied research in the application of the physical sciences of physics, electrochemistry, biotechnology and electronics for the Future Combat Systems (FCS) and the Objective Force. These technologies support thrusts aimed at enhanced battlefield situational awareness, increased vehicle mobility, reduced acquisition cost, and reduced operations and support costs; they are critical to the realization of the vision of a medium weight force with the capability to detect, target, and engage the enemy of the future. The technical areas addressed under this project are: frequency control; electro-optic sensors to include eye safe laser radar and midwave infrared (MWIR, 3- to 5-micron) and longwave (LWIR, 8- to 12-micron) bands; microelectromechanical systems (MEMS) for multi-function radio frequency (RF) applications as well as smart munitions (e.g., inertial measurements); advanced 16-18, 35, and 95 GHz (Ku, Ka and W-band) modules for RF applications; high temperature high power inverter circuits for all-electric vehicles; rechargeable lithium-ion batteries, and methanol fuel cells for individual soldier applications. Technical barriers include: more stable oscillators for frequency control in communications and location finding, more complete understanding of fundamental properties, growth techniques, and processing of new materials and their exploitation in electronic devices for uncooled infrared detectors, high voltage and high power control electronics; MEMS device design and fabrication techniques; RF microcircuit design; high power and high voltage power materials and device design. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1700 - Grew high quality boules of novel piezoelectric crystals, which are superior to quartz, and showed first time thin film growth of langasite for acceleration insensitive clocks.
- 6402 - Investigated high-power 1.5-micron diode laser 600-MHz frequency modulated/continuous wave (FMCW) chirp-modulated source and tested first sample of detector/mixer for scannerless laser radar (ladar).
  - Created and tested acousto-optic tunable filter (AOTF) hyperspectral imagers in the 3- to 5-micron and 8- to 12-micron bands.
  - Achieved growth of mercury cadmium telluride (HgCdTe) for MWIR and LWIR detection on silicon substrates.
- 8280 - Evaluated MEMS, diode and photonic actuated silicon tab array switches to provide multi-beam generation capabilities to enable multiple RF functions such as secure point-to-point communications, combat Identification, etc. through a common aperture to reduce the proliferation of antennas on the battlefield.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602705A - Electronics and Electronic Devices**

PROJECT

**H94**

## FY 2000 Accomplishments (Continued)

- Assessed radar and communication specifications for new direct digital synthesizer technology to provide waveform diversity to achieve high resolution, reduction of target scintillation and multi-path effects and enhanced electronic countermeasures.
- Assessed advanced Ku band (16-18 GHz), Ka-band (35 GHz) and W-band (95 GHz) devices and modules such as: wide-band 35 GHz low-noise amplifiers; high power gallium arsenide (GaAs) 16-18 GHz amplifiers, and low-noise indium phosphide (InP) 95 GHz amplifiers for multi-function RF applications.
- Advanced the state-of-the-art in temperature insensitive ferroelectric materials for electronically scanned antennas.
- Built inverter circuit for all-electric future ground combat system to provide increased mobility.
- Designed and produced prototype lead zirconium titanate MEMS magnetometer for projectile guidance, counting revolutions and remote sensing for incorporation into 2.75" rocket
- Constructed and evaluated 94 GHz diode based phase shifter monolithic microwave integrated circuit (MMIC) to enable electronic antenna scanning capabilities for multi-function RF systems.
- 3782 - Formulated primary lithium battery for Land Warrior with new cathode material for improved low temperature capacity.
- Formulated capacitors and rechargeable lithium-ion batteries for Future Combat Systems (robotic platforms, vehicles, individual soldier) with high voltage electrolytes and high energy anodes.
- Optimized anodes for methanol fuel cells for individual soldier applications.
- 3000 - Examined a range of physical characteristics of displays, measuring display performance and strategizing for performance enhancements of displays intended for military platforms. Provided documentation on display standards (national/international) and testing procedures/protocols for RDECs, PEOs and PMs to use in performing system level tradeoff analyses for alternative display technologies.

Total 23164

## FY 2001 Planned Program

- 2669 - Show factor of 10 improvement in acceleration insensitivity and phase noise in frequency control devices through application of new materials and clock architectures to provide highly stable high data rate communications and Global Positioning Systems (GPS) to meet FCS and Objective Force requirements (e.g., network centric force).
- 5877 - Provide ladar with detector/mixer line array.
- Show feasibility of long range scannerless ladar at eye-safe wavelength.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602705A - Electronics and Electronic Devices**

PROJECT

**H94****FY 2001 Planned Program (Continued)**

- 8436
  - Provide dual color 3-5 microns/8-12 microns HgCdTe infrared (IR) detector array grown on silicon substrate.
  - Integrate Rotman lens with MEMS switch array for electronic azimuth scanning in order to develop multifunction RF systems for FCS and the Objective Force.
  - Design direct digital synthesizer module to support multi-function RF systems.
  - Begin design effort for a smaller, lighter weight advanced transmit/receive module to include low noise receiver, high power transmitter, and smart power flow and switch control which has application for electronically scanned phased array antennas.
  - Design and prove out X-band ferroelectric module to produce an adaptive multi-tap phase shifter for elevation scanning antenna applications and start the design for a Ka-band ferroelectric phase shifter for electronically scanned antennas.
  - Optimize circuit for all-electric vehicle drive circuit for operation at high temperature (400 degrees C) to provide increased mobility.
- 2541
  - Formulate lithium-ion batteries with new low temperature, low flammability electrolytes for FCS (vehicles, robotic platforms, individual soldier) hybrid power systems.
  - Evaluate stability of battery materials for long storage, smart munitions applications.
  - Prove out a methanol fuel cell with 5X improvement over batteries for Land Warrior power.
- 139
  - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 19662

**FY 2002 Planned Program**

- 2355
  - Prove out ultra low phase noise millimeter wave optoelectric oscillator for radar and communication.
  - Construct and show low-insertion-loss narrow-bandwidth anti-jam filter for GPS.
- 5023
  - Build and test a breadboard ladar sensor for robotics navigation, collect relevant data and begin analysis.
  - Investigate AOTF cells for the 3- to 5-micron and 8- to 12-micron bands with potential for less than 50% diffraction efficiency.
  - Integrate laser range finding and target profiling on same detector array.
- 10220
  - Integrate vertically scanned Ka-band array with Rotman lens antenna to form two-dimensional electronically scanned antenna for high performance multi-function RF systems for FCS and the Objective Force.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602705A - Electronics and Electronic Devices**

PROJECT  
**H94**

**FY 2002 Planned Program (Continued)**

- Integrate silicon germanium (SiGe) direct digital synthesizer module into multi-function RF testbed for rapid flexible waveform generation.
- Incorporate multilevel construction using InP & GaAs MMICs and MEMS technologies to design and fabricate a transmit/receive array for a multi-port radar and communication system using an electronically scanned antenna.
- Show ultra low phase noise millimeter wave optoelectric oscillator for radar and communication.
- Design a MEMS based low-loss RF switch with active open/close drive using lead zirconium titanate to enable electronic antenna scanning capabilities for RF systems.
- Design a metamorphic heterojunction bipolar transistor to enable low-cost production of highly linear active devices for use in multi-function RF systems.

- 2729 - Evaluate additives to stabilize capacity retention at elevated ambient temperatures of lithium-ion batteries for FCS and Objective Force applications.
- Formulate battery chemistries for mini-reserve batteries with assured high-temperature shelf life for smart munitions.
- Explore new catalysts for fuel reformation for FCS (individual soldier, robotic platforms) applications.
- 3000 - Rapidly accelerate promising technologies through the Power and Energy Collaborative Technology Alliance (CTA) to transition to the Objective Force. This technology consists of radio frequency indium phosphide for advanced electronics.

Total 23327

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602709A - Night Vision Technology</b>						<b>PROJECT</b> <b>H95</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H95 NIGHT VISION & EO TECH	22734	23746	20598	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) researches, investigates and applies core night vision, and electronic sensor technologies to improve the Army's Objective Force capability to operate in, and own the dark. Technologies and applications under this PE are an integral part of the Future Combat Systems (FCS). This PE provides the Objective Force warrior with new, or enhanced, capabilities to see farther on the battlefield, operate in obscured conditions, and maintain a higher degree of Situational Awareness (SA). It provides cost savings, performance reliability, and reduction in the size and weight of sensor and data display systems. Technologies also are being investigated to reduce the power requirements, and power consumption of the electronics. The use of a distributed network of thermal, acoustic, magnetic and other micro-sensors will provide the Objective Force with potentially revolutionary increases in battlespace awareness. This will improve the overall survivability, lethality and SA. It will enable commanders and staff to plan and execute more effectively at increased Operational Tempo (OPTEMPO). Micro-laser sources will provide the individual soldier with affordable, high performance tactical laser range-finding, target designation, obstacle avoidance and laser radar (LADAR). Innovative near wavelength IR (NIR) and short wavelength IR (SWIR) sensors provide low power, eye-safe, micro-laser illumination to increase range for target identification. Solid state SWIR sensors will passively image and detect high velocity, kinetic energy munitions under low light conditions. Imaging sensors are being designed and fabricated for the Anti-Personnel Landmine Alternative (APLA) program. This PE also will design and fabricate advanced electronics to improve the contrast, and brightness, of miniature, flat-panel displays for use by infantry, armored, aviation and field maintenance organizations. Aided/Automatic Target Recognition (ATR) technologies will enable dramatic reductions in the time necessary to acquire targets, detect landmines, and collect intelligence data, while reducing the warfighter's cognitive workload. The ATR Center of Excellence will quantify the performance and utility of ATRs. Sensor models will be created to accomplish trade studies and performance predictions. Models also will support constructive simulation/wargaming for analysis of alternatives. Hardware-in-the-loop, multispectral sensor simulations will support end-to-end predictive modeling and evaluation of new technologies in a virtual environment. This will allow warfighters to train in a non-threatening environment, employing maturing technologies and hardware to develop operational capabilities, concepts of operations, and Tactics, Techniques and Procedures (TTPs). This PE supports Soldier Systems that will transition to the Objective Force. Work in this PE contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0602712A (Countermining Technology) and PE 0603710A (Night Vision Advanced Technology). Work in this PE 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. This program is managed by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA. Contractors include: Boeing, Anaheim, CA; EOIR, Spotsylvania, VA; Fermionic, Simi Valley, CA; Fibertek, Herndon, VA; Kaiser, San Jose, CA; Litton, Orlando, FL; Lockheed Martin, Lexington, MA; Planar Systems, Beaverton, OR; Raytheon, Dallas, TX; Rockwell, Thousand Oaks, CA; SAIC, San Diego, CA; Sarnoff, Princeton, NJ; TRW, Fairfax, VA; and VG Semicon, Beverly, MA. This program supports

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602709A - Night Vision Technology**

PROJECT  
**H95**

the Objective Force transition path of the Transformation Campaign Plan (TCP).

## FY 2000 Accomplishments

- 3919 - Designed and matured a 1024x1024 detector with long wavelength infrared (LWIR) FPA for application to overhead sensor technology for battlefield awareness.
  - Integrated analog to digital (A/D) conversion circuitry on an IR FPA to reduce read-out circuit noise, and improve detector response to target, or background temperature differences.
  - Established a new lab for uncooled technology to develop and test alpha-silicon test structures.
  - Evaluated, in collaboration with industry, an advanced read-out integrated circuit (ROIC) with non-uniformity correction circuitry on an IR FPA, to calibrate all detector pixels and provide a uniform response to target, or background, temperature differences.
  - Collected target, and background signature data with dual color, and near IR cameras to support comprehensive characterization of reflectivity differences of typical "un-modified" targets, camouflaged targets, cultural background objects, and natural background materials.
- 895 - Established prototype fabrication processes for growing next generation, multi-spectral IR detector arrays directly on a silicon semiconductor ROIC.
- 4604 - Designed solid state NIR FPA for operation at 2.0 microns and 2KHz frame rate for threat warning applications.
  - Designed low noise FPA for pulse gated laser imaging applications. Demonstrated 1.5 micron photocathode for pulse gated imaging applications.
- 3730 - Constructed and distributed models that better represent advanced EO sensor technologies (i.e. scanning vs. staring sensors). Made significant progress improving the search model.
  - Established a multispectral simulation environment to support design trade-offs, maturation, and evaluation of various advanced sensor programs.
  - Performed multiple validation efforts on the IR sensor simulation.
  - Integrated realistic interactive sensor simulation capability into the Mounted Maneuver Battle Lab at Fort Knox, KY and the Military Operations In Urban Terrain (MOUT) site at Fort Benning, GA.
- 1225 - Established and evaluated ATR processing architecture using adaptable computing technology for space/volume constrained applications and platforms.
  - Constructed partitioning and software translation tools that allow hardware specific ATR software to be ported to different processing architectures.

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

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602709A - Night Vision Technology**

PROJECT  
**H95**

**FY 2000 Accomplishments (Continued)**

- Evaluated utility of synthetic forward looking IR (FLIR) imagery for ATR. Established baseline of FLIR ATR performance.
  - 1372 - Integrated IR/charge coupled device (CCD) micro-sensors with acoustic and seismic micro-sensors to increase effectiveness of distributed sensor nodes in distinguishing between different targets or threats.
  - Constructed a comprehensive uncooled IR FPA model for defining theoretical performance limits.
  - Constructed fixed network of IR micro-sensor arrays to enhance target detection capabilities, define communication links, and define training requirements.
  - Designed instant-on capability for uncooled IR micro camera.
  - 2058 - Developed low power 640x512 pixel flat panel displays and associated drive electronics for dismounted soldier applications.
  - 980 - Matured a low cost 1 lb. micro-laser that provides 2Km range performance.
  - 233 - Completed testing on the Cooperative Eyesafe Laser Project (CELRAP) (Partner: Japan).
  - 686 - Matured active and passive polarization sensors in the visible, 1-2.5, and 3-5 micron wavebands. Improved cueing and clutter rejection.
  - 3000 - Modeled, matured and evaluated critical components of Congressional interest combustion driven laser. Critical components include the low threshold fiber clad laser, optimum brightness optical combustion sources, and efficient light-pipe optical couplers.
  - 32 Laser study
- Total 22734

**FY 2001 Planned Program**

- 4125 - Develop a prototype process for fabricating micro-lenses on focal planes to focus incident radiation on small pixel detectors. Provide improvements in detector sensitivity and sensor performance.
- Mature and test prototype advanced lithography process to reduce the number of fabrication steps for IR FPAs.
- Fabricate and test alpha-silicon wafer in-situ contacts using NVESD micro factory facilities.
- 1536 - Investigate and mature prototype process for semiconductor microfactory fabrication of ROIC that will be required to simultaneously readout the response from high speed, large area (640x480 and 1024x1024 element) dual color FPAs. Limited capacity readout circuits are a major technical barrier to higher performing next generation IR devices.
- Design next generation mid wavelength IR (MWIR) and LWIR FPA devices to provide high performance at elevated operating temperatures (120K vs. current 77K).



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602709A - Night Vision Technology**

PROJECT  
**H95**

**FY 2001 Planned Program (Continued)**

- 4550 - Complete testing and evaluation of near IR 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 IR and far IR sensor for dismounted soldier applications. Provide a fused output of the two spectral bands to enhance the operator's perception of "color" contrast, shadows, and depth.
- 3370 - Extend development of search and target acquisition sensor predictive modeling. Transition algorithms to constructive modeling and wargaming community.  
- Mature performance prediction models of multispectral sensor systems and target acquisition for specific targets.  
- Improve model prediction for environmental effects impact on sensor performance.  
- Incorporate additional sensor simulation capabilities that better represent complex urban terrain, and the battlefield environment.  
- Establish initial simulation tool set to support maturation of systems which use advanced, integrated, distributed, networked sensors. Transition tool set for use in Battle Lab experiments.  
- Continue sensor simulation validation efforts.
- 805 - Construct an open "heterogeneous" ATR processor architecture capable of hosting ATR software/algorithms designed for unique, or propriety, hardware. Reduce the time and cost required to integrate ATR capability into new platforms.  
- Establish standardized methods and procedures for mine detection ATRs.  
- Investigate emerging sensor technologies and ATR performance evaluation technology and methods.
- 1490 - Evaluate small scale integrated network of acoustic, seismic, and IR imaging micro-sensors to provide a significant unattended tactical sensing capability. Detect, track, and classify time critical mobile and stationary targets.  
- Evaluate low power consumption micro-sensors. Support electronics that permit unattended micro-sensor operation for up to 60 days.  
- Perform experiments utilizing prototype micro-sensor nodes in various configurations. Optimize warfighter effectiveness.
- 2100 - Mature full color, 640 x 512 pixel, flat panel display technology to enhance dismounted soldier performance through the use of color maps and symbology.  
- Mature color, 800 x 600 pixel, flat panel display technology for mounted and aviation applications.
- 1100 - Mature eyesafe micro-lasers capable of 2500 meter range performance and more than 5 shots per second.
- 237 - Perform final demonstration in CELRAP.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602709A - Night Vision Technology**

PROJECT  
**H95**

**FY 2001 Planned Program (Continued)**

- 700 - Mature on-chip neomorphic processing, hyperspectral spatial and temporal signature processing for development of compact, high performance sensors.
  - 3422 - Construct, analyze, and evaluate, fully portable prototype of combustion driven eyesafe, self-powered laser, and its control electronics.
  - 310 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 23745

**FY 2002 Planned Program**

- 4848 - Mature alternate readout circuit electronic technology to achieve small pixel geometry without performance reductions.
  - Mature A/D conversion techniques suitable for incorporation on FPA to improve sensitivity and dynamic range. Enable target identification at current detection ranges.
  - Investigate high operating temperature modes of IR FPAs against performance requirements.
  - Establish new techniques for etching detector material for high aspect ratios to achieve larger collection efficiency in multi-color detector stacked photodiodes and better pixel-to-pixel isolation.
  - Mature high frame rate (small time constant) material structures in alpha-silicon.
  - Investigate anti-reflection structures on micro-lenses for improved collection efficiency.
- 1279 - Establish baseline ATR performance for multi and hyperspectral sensors. Include those having advanced filtering and processing capability.
  - Investigate optimal human use of intelligent sensors for military applications.
  - Develop ATR hardware/software business plan to address the acquisition, and life cycle support requirements associated with introduction of ATR technology into Army tactical systems.
  - Show real-time reconfiguration of adaptable processor hardware, which could reduce the size, weight, and power requirements typical for ATR processors.
  - Host target cueing algorithms on real-time commercial-off-the-shelf (COTS) hardware. Evaluate performance.
  - Collect additional ATR problem set data to support algorithm maturation and evaluation.
- 3632 - Leverage clutter metric and shape characterization efforts for maturation and evaluation of a performance predication capability useful for specific targets.
  - Complete modeling of multispectral sensor systems.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602709A - Night Vision Technology**

PROJECT  
**H95**

**FY 2002 Planned Program (Continued)**

- Integrate environmental effects into model.
  - Complete validation of 8-12 micron thermal sensor simulation.
  - Continue validation of other sensor simulation bands.
  - Advance state-of-the-art for simulation of distributed networked sensor simulation. Transfer improvements to battlelabs.
  - Complete sensor simulation for better representation of complex urban terrain and the dirty battlefield environment. Begin development of dynamic terrain representations.
  - 4048 - Mature extremely low power IR imaging micro-camera with instant-on capability.
  - Investigate alternate components in a set of micro-sensors (acoustic, seismic, magnetic, IR tripwire, laser tripwire, etc.). Optimize ATR function in an isolated network of micro-sensors.
  - Mature low power, compact micro-sensor network for field experimentation.
  - 5065 - Mature 1920x1080 pixel, high-brightness, monochrome Active Matrix Liquid Crystal Display (AMLCD) for aviation platforms.
  - Mature EO-Attenuator for active sunglass tinting of helmet mounted displays (HMDs).
  - Characterize performance of 640x512 pixel, full color, flat panel displays for the soldier.
  - 939 - Integrate micro eyesafe solid state laser devices with receiver. Evaluate 2500 meter ranging at 5 hertz, using low cost laser technology.
  - 787 - Investigate multispectral and polarization imaging phenomenology as part of a fused sensor suite, with an active laser ranging sensor.
- Total 20598

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

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602709A - Night Vision Technology**

PROJECT  
**H95**

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	20021	20465	20574	0
Appropriated Value	20111	23965	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-319	0	0	0
c. Omnibus or Other Above Threshold Reductions	-49	0	0	0
d. Below Threshold Reprogramming	32	0	0	0
e. Rescissions	-41	-219	0	0
f. OSD Realignment	3000	0	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	24	0
Current Budget Submit (FY 2002/2003 PB )	22734	23746	20598	0

In FY01, Congress added (\$3500) million for Combustion-Driven Eye Safe Self Powered Laser, to mature and field a three-dimensional identification friend-or-foe system capable of identifying aircraft and vehicle threat systems in real-time.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602712A - COUNTERMINE AND BARRIER TECHNOLOGY**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	15054	17721	16689	0	0	0	0	0	0	0
H24 COUNTERMINE TECH	13011	15333	14214	0	0	0	0	0	0	0
H35 CAMOUFLAGE TECHNOLOGY	2043	2388	2475	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) researches and investigates advanced technologies to improve countermine, signature management and deception capabilities for the Army's Transformation to the Objective Force. Countermining research focuses on system concepts and technologies that improve mine detection and neutralization from standoff man-portable, ground and air platforms. The goal is to increase mine detection probability, while also reducing false alarm rate, to maintain high Operational Tempo (OPTEMPO) in the Objective Force. Emerging mine threats in both the conventional and electronically activated categories are being addressed by this PE. A Center of Excellence (COE) for Landmines has been established to coordinate and standardize land mine signature models; maintain a catalogue of mine signatures; and support the evaluation of mine detection sensors and algorithms. This PE also researches deception and robust signature management techniques that will potentially alter an adversary's perception of friendly force capabilities and intentions. This effort is completely coordinated with the Marine Corps. The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. It also adheres to Tri-Service/Project Reliance Agreements on conventional air/surface weapons and ground vehicles. This PE contains no duplication with any other effort within the Army, or the Department of Defense. It also is fully coordinated with PE 0602709A (Night Vision and Electro-Optics Technology), PE 0603606A (Countermining and Barrier Development) and PE 0603710A (Night Vision Advanced Technology). This PE is managed by the Night Vision Electronic Sensors Directorate (NVESD), Communications-Electronics Research, Development and Engineering Center (CERDEC). Contractors include: EOIR, Spotsylvania, VA; IMT, San Jose, CA; SAIC, San Diego, CA; and TRW, Fairfax, VA.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602712A - COUNTERMINE AND BARRIER TECHNOLOGY**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	14380	12386	12639	0
Appropriated Value	14521	17886	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-326	0	0	
c. Omnibus or Other Above Threshold Reductions	-50	0	0	
d. Below Threshold Reprogramming	1000	0	0	
e. Rescissions	-91	-165	0	
Adjustments to Budget Years Since FY2001 PB	0	0	4050	
Current Budget Submit (FY 2002/2003 PB )	15054	17721	16689	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for Nonlinear Acoustic Mine Detection (+1000), Acoustic Mine Detection (+2500) and Landmine Warfare and Barrier Advanced Development (+2000).

- (+1000) For design, investigation, modeling and application on nonlinear acoustic techniques for phenomenology assessment of imaging surface and buried anti-tank/anti-personnel (AT/AP) landmines.
- (+2500) For investigation, modeling and application of acoustic/seismic energy for detection and discrimination of AT/AP land mines from downward and forward-looking sensor modalities.
- (+2000) For assessment of forward-looking radar and IR technologies for detection and discrimination of AT land mines at distances greater than

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602712A - COUNTERMINE AND BARRIER  
TECHNOLOGY**

10 meters.

FY 2002: Additional funds (+4000) were added for investigation and assessment of sensor technologies for wide area mine detection and surveillance.

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

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**BUDGET ACTIVITY**  
**2 - APPLIED RESEARCH**

**PE NUMBER AND TITLE**  
**0602712A - COUNTERMINE AND BARRIER**  
**TECHNOLOGY**

**PROJECT**  
**H24**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H24 COUNTERMINE TECH	13011	15333	14214	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures countermine technologies for standoff detection and discrimination of individual mines and minefields from manportable, ground vehicular and airborne platforms. Specific activities include close-in detection and neutralization of individual mines and minefields from handheld, ground and aerial sensor systems. Envisioned mines include both conventional and electronically activated mines. Data collections will be used to assess the ability of various sensor combinations, as well as signal processing/fusion algorithms, to consistently detect mines at reduced false alarms for increased force OPTEMPO. This project sponsors the COE established to coordinate and standardize land mine signature models; maintain a catalogue of mine signatures; and support the evaluation of mine detection sensors and algorithms. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1455 - Designed laser illumination source with charge coupled device (CCD) camera for mine phenomenology data collections to support surface mine detection from an airborne platform.  
- Evaluated laser/CCD camera testbed and collected data which defined conditions and observable phenomena to optimize the multi-sensor approach.
- 3116 - Evaluated and assessed advanced mine detection sensors and downselected to the most promising technologies and techniques. Collected and analyzed data to evaluate improvements in probability of detection and reduction of false alarm rates.  
- Completed design and tradeoff analyses of an acoustic laser Doppler vibrometer breadboard prototype to determine system parameters for detecting AT mines at greater standoff distances with possible application in the forward looking and close-in application areas.  
- Evaluated industry/academia concepts and technologies that may enhance force mobility and survivability by increasing the probability of detection, reducing false alarms or increasing standoff distances.  
- Established standards and techniques for evaluation of these mine detection technologies at various test sites to include Fort AP Hill, VA and Yuma Proving Ground, AZ.  
- Designed and matured processing capabilities for acoustic/laser, synthetic aperture radar (SAR)/ground penetrating radar (GPR), quadrupole resonance (QR), and novel metal detector technologies for the Advanced Mine Detection Sensors program to reduce false alarms and increase OPTEMPO.



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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602712A - COUNTERMINE AND BARRIER  
TECHNOLOGY**

PROJECT

**H24**

## FY 2000 Accomplishments (Continued)

- 485 - Enhanced mine signature simulations, updated database of mine signatures, and established methodology for evaluation of detection algorithms in support of landmine detection Joint Unexploded Ordinance Coordination Office (JUXOCO).
- 2910 - Evaluated forward-looking detection sensor designs (GPR and IR) through testing in Yuma Proving Ground, AZ and Fort AP Hill, VA against surface and buried AT mines with the goal of improving probability of detection and reducing false alarm rates for on route missions.  
- Evaluated forward looking detection sensor technologies with the goal of improved probability of detection and reduced false alarm rates while increasing operational speed.  
- Transitioned technologies into data collection devices for continual evaluation and assessment of sensors and algorithms.
- 1746 - Evaluated and assessed acoustic laser Doppler vibrometer (LDV) against AT and AP mines on varied environmental backgrounds. Designed, built and assessed new laser source technologies for LDV to increase area coverage and reduce scanning time. Reduced and isolated acoustic noise at LDV receiver for increased detection of mines.
- 1359 - Evaluated standoff GPR and infrared (IR) technologies in temperate environment against AT mines at standoff distances of 10-30 meters.
- 970 - Investigated non-linear acoustic technology for AT mine detection and evaluated the technology against surface AT mines in realistic environments along with modeling of acoustic phenomena.
- 970 - Evaluated advanced QR sensor for vehicular use in confirmation and/or scanning modalities. Hastened the technology transition to the ground stand-off mine detection system (GSTAMIDS) Block I spiral development program.

Total 13011

## FY 2001 Planned Program

- 3605 - Investigate and evaluate algorithms and sensor fusion processing for mine data collection systems in field experiments and evaluation.  
  
- Conduct and evaluate field experiments using chemical sensors against realistic explosive concentrations to establish the prototype's operational envelopes as a function of target type, environment, and operational speed.  
- Test and evaluate acoustic/laser, ground penetrating - synthetic aperture radar, and advanced electromagnetic detection sensors for increased mine detection and discrimination capabilities.
- 487 - Continue to enhance mine signature simulations, update database of mine signatures, and establish methodology for evaluation of detection algorithms in support of landmine detection JUXOCO.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602712A - COUNTERMINE AND BARRIER  
TECHNOLOGY**

PROJECT

**H24**

## FY 2001 Planned Program (Continued)

- 5528 - Evaluate brassboard forward-looking sensors for the detection of surface and buried AT mines that will improve probability of detection and reduce false alarms to provide faster rates of advance and survivability for the Objective Force.
  - Evaluate initial Aided Target Recognition (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.
  - Evaluate potential of acoustic time domain electromagnetic induction sensors and advanced mine detection sensors for inclusion in ongoing downward and forward looking mine detection programs as primary detection sensor.
  - Perform analysis, modeling and laboratory experiments on candidate standoff mine neutralization technologies to identify promising approaches for maturing spot (rather than area) neutralization providing enhanced survivability while reducing size, weight and logistics burdens.
- 965 - Investigate, model and apply nonlinear acoustic techniques for phenomenology assessment of imaging surface and buried anti-tank/anti-personnel land mines in this Congressional interest program.
- 2401 - Investigate, model and apply acoustic/seismic energy for detection and discrimination of anti-tank/anti-personnel landmines from downward and forward-looking sensor modalities in this Congressional interest program.
- 1920 - Assess forward looking radar and IR technologies for detection and discrimination of anti-tank landmines at distances of greater than 10 meters on routes. This land mine warfare and advanced barrier maturation is a Congressional interest effort.
- 427 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 15333

## FY 2002 Planned Program

- 7400 - Investigate and evaluate electronically scanned ground penetrating - synthetic aperture radar (GP-SAR) and forward looking acoustic sensors for phenomenology assessment of mine detection data collection systems in field experiments to support the Army Transformation to the Objective Force.
  - Investigate and evaluate algorithms and sensor/data fuse the GP-SAR, infrared, and acoustic sensors for fusion processing to reduce false-alarms while increasing the probability of detection and operational tempo.
  - Conduct field experiments using forward looking mine detection data collection systems to evaluate target type, environment, and operational speed to enhance rate of advance and survivability of the Objective Force.
  - Modify, evaluate and validate modeling of forward looking mine detection sensors.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602712A - COUNTERMINE AND BARRIER  
 TECHNOLOGY**

PROJECT  
**H24**

**FY 2002 Planned Program (Continued)**

- Investigate candidate standoff neutralization technologies for precision neutralization of surface and buried mines.
- 508 - Continue to enhance mine signature simulations, update database of mine signatures, and establish methodology for evaluation of detection algorithms in support of landmine detection JUXOCO.
- 2306 - Apply and investigate sensor technologies for trip wire detectability. Investigate nonlinear and imaging acoustics for AT and AP mine detection for ground vehicle and robotic platforms.
- 4000 - Investigate and assess sensor technologies and collect sensor data for signal processing/clutter rejection to support wide area minefield detection and surveillance.
- Candidate sensor technologies include multispectral long wave infrared fused with short wave infrared laser polarization, hyperspectral infrared, ultra wideband ground penetrating synthetic aperture radar.

Total 14214

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602712A - COUNTERMINE AND BARRIER TECHNOLOGY**

PROJECT  
**H35**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H35 CAMOUFLAGE TECHNOLOGY	2043	2388	2475	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project researches and investigates advanced signature management and deception technologies for masking friendly force capabilities and intentions, thereby increasing Objective Force unit survivability. This work is applicable to the Future Combat Systems (FCS) and other assets in the Objective Force. Specific research areas include: (1) advanced materials and processes for countering visual and infrared sensors; (2) simulation of key radar and communications signatures using electronic deception modules; (3) advanced modeling and simulation of proposed signature management and deception technologies; and (4) advanced materials, coatings, patterns and appliques for suppressing electro-optical (EO) signatures of combat units. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2043 - Investigated 3-D image projection techniques, materials, and processes for visual and IR deception devices.
- Established modeling and simulation capabilities for design, maturation and evaluation of signature management and deception technologies.
- Investigated optical communication technologies to suppress combat unit radio frequency (RF) signatures.
- Investigated and formulated patterns, coatings, and materials for suppression of visual and EO signatures of combat units.

Total 2043

**FY 2001 Planned Program**

- 2321 - Mature 3-D image projection techniques in the laboratory that improve deception capabilities for combat units.
- Evaluate effectiveness of signature management and deception system design alternatives through modeling and simulation in laboratory experiments and force-on-force simulations.
- Evaluate effectiveness of improved signature management coatings, materials and patterns in visual and thermal bands through lab and field testing.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602712A - COUNTERMINE AND BARRIER  
TECHNOLOGY**

PROJECT

**H35**

## FY 2001 Planned Program (Continued)

- Investigate signature management materials having improved spectral performance against advanced threat multispectral sensors.
- Evaluate requirements and technologies for communications deception systems to defeat threat electronic intelligence collection assets.

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

Total 2388

## FY 2002 Planned Program

- 2475 - Incorporate improved visual, thermal and spectral coatings and materials into signature management components for field experiments.
- Assess performance of breadboard communications deception system in laboratory testing.
- Evaluate performance of signature management and deception suites for the TOC using predictive modeling and force-on-force simulations.
  
- Demonstrate techniques that combine physical and electronic decoys with signature management technologies to improve survivability of combat and combat support units.

Total 2475

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

June 2001

BUDGET ACTIVITY  
2 - APPLIED RESEARCH

PE NUMBER AND TITLE  
0602716A - Human Factors Engineering Technology

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	19428	18119	16466	0	0	0	0	0	0	0
H34 RURAL HEALTH TECH	3246	2478	0	0	0	0	0	0	0	0
H70 HUMAN FACT ENG SYS DEV	16182	15641	16466	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The primary objectives of this program are to maximize the effectiveness of soldiers in concert with their materiel so that they may survive and prevail on the battlefield in the context of the Army Transformation to the Objective Force. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of soldiers, with particular attention on soldier and equipment interaction. The Congressionally directed program on Rural Health Technology focuses on the researching, field testing, and empirical validation of methods for improving the coordinated functioning of civilian and military emergency medical teams. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Research Laboratory.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602716A - Human Factors Engineering Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	19681	15786	16444	0
Appropriated Value	19792	18286	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-254	0	0	
c. Omnibus or Other Above Threshold Reductions	-39	0	0	
d. Below Threshold Reprogramming	1	0	0	
e. Rescissions	-72	-167	0	
Adjustments to Budget Years Since FY2001 PB	0	0	22	
Current Budget Submit (FY 2002/2003 PB )	19428	18119	16466	0

Change Summary Explanation: Funding - FY 2001: A Congressional add was received for H34, Rural Health Technology (+2500), to expand Med Teams into a broader base of medical settings, including integration with advanced life support algorithms and advanced cardiac life support technology.

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602716A - Human Factors Engineering Technology</b>					PROJECT <b>H34</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H34 RURAL HEALTH TECH	3246	2478	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This is a congressionally funded program. The Medical Teams program provides for the researching, 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 assessing the "value- added" of selected telemedicine and medical decision management technologies.

**FY 2000 Accomplishments**

- 3245 - Completed validation study of MedTeams in emergency departments, showing an 80% reduction in clinically significant errors.
- Continued moving the MedTeams system into military field environments with a real-world demonstration and validation testbed using active assets of the 44th Medical Brigade including the 28th and 86th Combat Support Hospitals.
- Began extending MedTeams implementation beyond emergency departments, with Labor and Delivery selected for the next specialty area.
- Completed investigation of MedTeams cost-effective sustainment methods in the emergency department.

Total 3245

**FY 2001 Planned Program**

- 2500 - Begin cross validation of MedTeams into Labor and Delivery departments by completing the needs assessment and beginning full-scale development of a test system.
- Continue refinement of basic and sustainment methods for MedTeams, exploring the use of moderate cost next generation simulators to enhance learning and retention



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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602716A - Human Factors Engineering Technology**

PROJECT

**H34**

## FY 2001 Planned Program (Continued)

- Formulate mechanisms to integrate MedTeams into a broader base of medical settings, including integration with Advanced Life Support algorithms and Advanced Cardiac Life Support (ACLS) training.
- Extend validated cost effective methods for MedTeams sustainment to Combat Support Hospitals.

Total 2500

## FY 2002 Planned Program

- Project not funded in FY 2002.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602716A - Human Factors Engineering Technology**

PROJECT  
**H70**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H70 HUMAN FACT ENG SYS DEV	16182	15641	16466	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The goal of this program is to maximize the effectiveness of soldiers in concert with their equipment, in order to survive and prevail on the battlefield in the context of the Army Transformation to the Objective Force. The barriers to achieving the goal include incomplete soldier performance data and models of the new missions, organizations, and new and complex technologies transforming the Army. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of soldiers, with particular attention on soldier and equipment interaction. The resulting data are the basis for weapon systems and equipment design standards, guidelines, handbooks and soldier training and manpower requirements to improve equipment operation and maintenance. Application of advancements yields reduced workload, fewer errors, enhanced soldier protection, user acceptance, and allows the soldier to extract the maximum performance from the equipment. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 5026 - Completed the human factors analysis of XVIII Airborne Corps "Green Ramp" operations and generated task workload models to identify bottlenecks and streamline the ammunition logistics footprint for deploying units in support of the Defense Ammunition Logistics Agency.
- Completed field study to identify key human performance factors affecting maintenance manpower utilization rates.
- Evaluated new technique for predicting motion sickness in the Vetronics Technology Testbed (VTT). Completed report of results of indirect driving study, which provided TARDEC and Future Combat Systems (FCS) contractors the basis for display design in their concepts. Designed studies to compare results from indirect vision driving field tests with simulator environment to validate use of simulation rather than actual vehicles for future studies in support of FCS.
- Defined baseline task and workload models to target crew size reduction opportunities for the Crewstation Integration and Automation Testbed (CAT) Advanced Technology Demonstration (ATD), which supports FCS.
- Provided human factors guidelines on the design and use of 3-D audio and speech recognition interfaces to TARDEC for the Vetronics Technology Testbed and the Virtual Cockpit Optimization Program.
- Conducted a 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 stress and mental workload.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602716A - Human Factors Engineering Technology**

PROJECT  
**H70**

**FY 2000 Accomplishments (Continued)**

- Identified and categorized physiological and behavioral performance data and existing and emerging models for application to dismounted warrior modeling as part of the Warrior Systems Modeling Technology (WSMT) STO.
- Conducted an experiment to determine the effects of Objective Individual Combat Weapon (OICW) recoil levels on soldier shooting performance.

- 3299 - Provided predictive models of command and Control (C2) soldier performance under varying levels of stress, diverse staffing concepts, and advanced digitization technologies to TRADOC Program Integration Office (TPIO), Army Battle Command System (ABCS), TRADOC System Manager (TSM) and TSM TOC. (Cognitive Engineering STO)
  - Performed soldier focused assessments of various battlefield reasoning and multi-modal display systems to support commander and staff decision-making processes for BCBL-H.
  - Conducted human factors evaluation of ABCS functionality and maintenance of situation awareness in the battle command of light forces during the Joint Contingency Force (JCF) Advance Warfighting Experiment (AWE).
  - Completed 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 meets commander and staff military intelligence requirements.
- 5657 - Showed the feasibility of linking soldier operator models to separate system and environment models through standard computer communications (i.e., "high level architecture") for the purpose of system design evaluation.
  - Provided human factors engineering design guidance to STRICOM for development of a next-generation human locomotion interface for a dismounted soldier simulator. (Virtual Environment for Dismounted Soldier STO)
  - Provided Human Factors Engineering (HFE) and MANPRINT support to AMC, AMC RDECs, TRADOC Centers, Schools and Battle Laboratories, ATEC and other service laboratories. (Includes FCS Support)
- 2200 - Transitioned cognitive engineering STO products addressing critical training, leader development and soldier support (TLS) research issues to CECOM, DARPA, and TRADOC battlelabs.
  - Transitioned from the Advanced Displays and Interactive Displays Federated Laboratory, the course-of-action planning tool "FOX-GA" and accompanying applications to CECOM's "CADET" for Agile Commander ATD.

Total 16182

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602716A - Human Factors Engineering Technology**

PROJECT

**H70**

## FY 2001 Planned Program

- 4964 Provide CASCOM with recommendations on reducing manpower and improving performance in deploying units by completing a HF study to identify high manpower maintenance tasks.
  - Identify critical soldier performance metrics and establish plan for evaluation of FCS contractor concepts focused on cognitive workload in a sensor-rich environment, crew role versus automation in mission conduct, crew life-cycle cost, crew capability to control multiple unmanned systems, and dismounted soldier information needs. (CAT ATD)
  - Analyze soldier performance data from the FY 00 Vetronics Technology Testbed (VTT) STO and provide analysis to TARDEC and FCS contractors.
  - Provide TACOM with baseline crew station designs, which support FCS in preparation for FY 04 CAT ATD demo.
  - Evaluate contribution of new technologies such as voice recognition and 3-D audio to aviator performance in a virtual cockpit compared to traditional visual and tactile displays and controls.
  - Provide design guidelines to SBCCOM-NSC, the Infantry School and Dismounted Battlespace Battle Lab on the effects of advanced audio display technologies on dismounted soldier tasks performance.
  - Validate the dismounted soldier baseline day for use in evaluating soldier equipment interface and compatibility and transition to SBCCOM-NSC and the Infantry School. (WSMT STO)
  - Conduct study to determine the effect of weapon support and weight on soldier aiming accuracy for application to the Light Fighter Lethality program.
- 3771
  - Specify optimum configuration of staff and digitization capabilities by expanding models of C2 soldier performance during contingency, joint, strategic operations to TPIO-ABCS, DARPA Command Post of the Future (CPOF), and Joint and Army Vision 2010 doctrinal elements. (Cognitive Engineering STO)
  - Conduct follow-on human factors evaluation of ABCS functionality in the division command post exercise (DCX) to improve system integration in the first digital division.
  - Validate the intelligence production model (IPM) in intelligence field units at varying command levels.
- 5520
  - Conduct experiment on the utility of complex cognitive models embedded within soldier-system level models for practical system design evaluation.

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

June 2001

BUDGET ACTIVITY

2 - APPLIED RESEARCH

PE NUMBER AND TITLE

0602716A - Human Factors Engineering Technology

PROJECT

H70

## FY 2001 Planned Program (Continued)

- 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). (Virtual Environment for the Dismounted Soldier STO)

- Provide HFE and MANPRINT support to AMC, AMC RDECs, TRADOC Centers, Schools and Battle Laboratories, ATEC and other service laboratories.

- 1237 - Leverage Initial Brigade planning and experimentation to address cognitive engineering of battle command operations.  
- Transition final architecture, software and media of visualizations for multi-modal sensory computer control algorithms to the Agile Commander ATD.
- 149 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 15641

## FY 2002 Planned Program

- 4252 - Complete human factors concept evaluations with CASCOM and transition Roller Platform for Air Delivery and Palletized Loading System Shoe to TACOM.  
- Conduct field concept evaluations of new intermodal handling concepts at ammunition supply chain nodes for Defense Ammunition Logistics Agency (DALA) and Combined Arms Support Command (CASCOM) to create most effective and efficient ammunition deployment and sustainment operations.  
  
- Design more accurate tool to predict maintenance manpower, personnel, and training requirements for future weapons systems based on validated measures from FY00-01 field studies and data analysis.  
- Conduct soldier performance evaluations of the four FCS contractor concepts, identify promising concepts and potential problem areas, and provide results with the FCS Technical and Operational IPTs. Define additional research needed to meet objective force requirements for incorporation into CAT STO demo in FY 04.  
- Conduct experiments and field studies, using validated dismounted soldier metrics, to fill identified data voids and transition the results to the SBCCOM-NSC WSMT STO.  
- Prototype a comprehensive warfighter performance model using previously collected behavioral performance data and leverage NATO and USMA related work.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE <b>0602716A - Human Factors Engineering Technology</b>	PROJECT <b>H70</b>
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**FY 2002 Planned Program (Continued)**

- |   |      |   |
|---|------|---|
| • | 3834 | - Assess the effects of various target cueing and acquisition methods (audio, graphical, etc.) on soldier shooting performance and transition to the Light Fighter Lethality program.<br>- Refine models and tools for adaptive performance and document implications for their use in the development of training and support systems. (Cognitive Engineering STO)<br>- Provide definitive guidelines for using C2 soldier performance predictive models in conjunction with C2 measures used in live exercises to guide experimentation planning and analysis for primary ABCS related Battle Labs (BCBL, MMBL, DSABL).<br>- Refine a framework for assessing the human factors aspects of digitization to support Army force modernization efforts.<br>- Apply IPM to assess Intelligence Analyst of the Future initiatives. |
|---|------|---|
- |   |      |  |
|---|------|--|
| • | 6880 | - Provide cognitive processing models that better represent the details of soldier performance than simple task performance modeling alone, that are suitable for both stand-alone and linked modeling frameworks, and that include advanced performance shaping functions such as individual soldier characteristics and environmental stressors, all for the purpose of higher fidelity system design evaluation.<br>- Provide HFE and MANPRINT support to AMC, AMC RDECs, TRADOC Centers, Schools and Battle Laboratories, ATEC and other service laboratories. |
|---|------|--|
- |   |      |  |
|---|------|--|
| • | 1500 | - Complete the transition of Cognitive Engineering of the Digital battlefield (STO) products to CECOM, DARPA, and TRADOC battlelabs.<br>- Complete the installation, instruction, and documentation of FEDLAB products to DARPA and CECOM Agile Commander ATD. |
|---|------|--|

Total 16466

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

June 2001

**BUDGET ACTIVITY**  
**2 - APPLIED RESEARCH**

**PE NUMBER AND TITLE**  
**0602720A - Environmental Quality Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	76907	60434	16150	0	0	0	0	0	0	0
048 IND OPER POLL CTRL TEC	2153	2361	2539	0	0	0	0	0	0	0
829 NDCEE TECHNOLOGY	1909	0	0	0	0	0	0	0	0	0
835 MIL MED ENVIRON CRIT	2223	2822	2921	0	0	0	0	0	0	0
876 PLASMA ENERGY PYROLYSIS SYS	7638	0	0	0	0	0	0	0	0	0
896 BASE FAC ENVIRON QUAL	4908	5143	5136	0	0	0	0	0	0	0
908 COMMERCIAL TECHNOLOGY TO REDUCE COSTS	6684	0	0	0	0	0	0	0	0	0
917 COMPUTER BASED LAND MANAGEMENT	1909	0	0	0	0	0	0	0	0	0
91G TECHNOLOGIES TO REDUCE NON-HAZARDOUS WASTE	0	4954	0	0	0	0	0	0	0	0
946 ELECTRONIC EQUIPMENT DEMANUFACTURE	15275	12386	0	0	0	0	0	0	0	0
947 SUSTAINABLE GREEN MANUFACTURING	5251	5449	0	0	0	0	0	0	0	0
959 CORROSION MEASUREMENT & CONTROL PROJ	8593	0	0	0	0	0	0	0	0	0
960 WATERVLIET ARSENAL POLLUTION PROJECTS	3818	0	0	0	0	0	0	0	0	0
961 VESSEL PLATING TECHNOLOGY	955	0	0	0	0	0	0	0	0	0
F25 MIL ENV RESTOR TECH	3180	3540	5554	0	0	0	0	0	0	0
F28 RANGE SAFETY TECH DEMO	9547	4954	0	0	0	0	0	0	0	0
F29 PHYTO-REMEDICATION IN ARID LANDS	2864	0	0	0	0	0	0	0	0	0
F31 ENVIRONMENTAL CLEANUP AT PORTA BELLA	0	2972	0	0	0	0	0	0	0	0
F35 ENVIRONMENTAL QUALITY TECHNOLOGY	0	5945	0	0	0	0	0	0	0	0
F36 ARMY HEAVY METALS OFFICE	0	5945	0	0	0	0	0	0	0	0
F37 PROTON EXCHANGE MEMBRANE (PEM) FUEL CELL	0	3963	0	0	0	0	0	0	0	0

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602720A - Environmental Quality Technology**

## **A. Mission Description and Budget Item Justification:**

**PLEASE NOTE:** This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

The objective of this program element (PE) is to provide technologies that will improve the Army's ability to comply with regulations mandated by all Federal, state and local environmental/health laws and to reduce the cost of this compliance. Examples of key laws include the Superfund Amendments and Reauthorization Act of 1986 and the Defense Environmental Restoration Act (the Department of Defense 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. 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 in complying 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 PE is aligned with the Army's vision for the Objective Force and adheres to Defense Reliance Agreements on civil engineering and environmental quality with oversight provided by the Joint Engineers and Armed Services Biomedical Research Evaluation and Management. The cited work is also consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. Work is performed by the U.S. Army Engineer Research and Development Center (ERDC) and the U.S. Army Armament Research, Development and Engineering Center (ARDEC).



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602720A - Environmental Quality Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	78905	13994	14238	0
Appropriated Value	80258	60994	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-2011	0	0	
c. Omnibus or Other Above Threshold Reductions	-311	0	0	
d. Below Threshold Reprogramming	13	0	0	
e. Rescissions	-1042	-560	0	
Adjustments to Budget Years Since FY2001 PB	0	0	1912	
Current Budget Submit (FY 2002/2003 PB )	76907	60434	16150	0

FY02 and FY03 funding was increased to address high priority Army requirements for remediation of unexploded ordnance.

In FY01, Congressional adds were received for (947) Sustainable Green Manufacturing (\$5500), (F28) Range Safe Demonstration Program (TACOM-ARDEC) (\$5000), (F36) Army's Heavy Metals Office Initiative (\$6000), (F37) Proton Exchange Membrane (PEM) Fuel Cell Demonstration (\$4000), (91G) Technologies to Reduce Non-Hazardous Waste (\$5000), (946) Demanufacturing of Electronic Equipment for Reuse and Recycling (DEER2) (\$12500), (F35) Environmental Quality Technology (\$6000), and (F31) Environmental Clean-Up Demonstration at Porta Bella (\$3000). No additional funds are required to complete these projects.

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602720A - Environmental Quality Technology**

- (\$5500) Sustainable Green Manufacturing continues research supported by previous Congressional adds to introduce clean technologies and techniques into weapon system and related production lines.
- (\$5000) Range Safe Demonstration Program continues research supported by previous Congressional adds to investigate technologies for remediation of military firing ranges containing lead and low level radioactive materials.
- (\$6000) Heavy Metals Office Initiative to investigate remediation of heavy metals at military firing ranges.
- (\$4000) PEM Fuel Cell Demonstration to investigate use of residential PEM fuel cell technology in military facilities.
- (\$5000) Technologies to Reduce Non-Hazardous Waste for investigating technologies and processes applied to the reuse, recycle, or disposal of non-hazardous waste.
- (\$12500) Demanufacturing of Electronic Equipment for Reuse and Recycling continues research supported by previous Congressional adds to develop and demonstrate technologies and processes for the reuse, recycle, or disposal of manufactured electronic equipment.
- (\$6000) Environmental Quality Technology to transfer environmental pollution prevention/compliance technologies to Army industrial operations.
- (\$3000) Environmental Clean-Up Demonstration to investigate remediation technologies for environmental clean-up at Porta Bella.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602720A - Environmental Quality Technology**

PROJECT  
**048**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
048 IND OPER POLL CTRL TEC	2153	2361	2539	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide technologies to support the readiness condition of the Army's military installations and munitions manufacture, to accommodate force transformation, and provide support to the Objective Force. Specifically, this project emphasizes the reduction or elimination of the impacts of legal and regulatory restrictions that subject the Army to fines and liabilities, as well as avoiding facility shutdowns for violations of these restrictions. These new technologies are essential for the effective control and reduction of hazardous and non-hazardous wastes. Efforts will include a focus on new materials that will enter the Army inventory within the next decade supporting the Objective Force. The work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2153 - Identified weather-based propagation cases for assessment of long-term average noise exposure for small arms range noise model.
- Developed designs to minimize weather-based propagation cases for assessment of long-term average noise exposure for small arms range noise model.
- Developed designs to minimize reactor headloss during electrochemical reduction of energetic compounds in water.

Total 2153

**FY 2001 Planned Program**

- 2320 - Develop measures and criteria to predict and avoid negative community response to noise.
- Investigate modified absorbent/biosorbent technology for treating Army waste streams containing heavy and toxic metals and explosives.
- Establish guidelines for fluidized-bed granular activated carbon bioreactor to replace carbon absorption for water contaminated with explosives.
- 41 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2361

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602720A - Environmental Quality Technology**

PROJECT  
**048**

## FY 2002 Planned Program

- 2539 - Investigate reductive electrochemical treatment for destruction of nitro-aromatics, nitramine or nitrate esters.
- Determine physical and chemical interactions between energetic materials and building materials under long term exposure situations.

Total 2539

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602720A - Environmental Quality Technology**

PROJECT  
**835**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
835 MIL MED ENVIRON CRIT	2223	2822	2921	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project will provide quantitative means to determine the environmental and human health effects resulting from exposure to explosives, propellants, and smokes produced in Army industrial and field operations or disposed of through past activities. The end results of this research are determinations of acceptable residual concentration levels that will protect the environment and human health from adverse effects. The main product of this research is the Army Risk Assessment and Modeling System (ARAMS). This PC-based platform links models of fate and transport to the exposure and the effects models and databases of explosives and their degradation by-products on endpoint organisms in both aquatic and terrestrial ecosystems. This will reduce the uncertainty associated with both the probability of exposure and the ultimate effect if exposed. Interim products are U.S. Environmental Protection Agency approved health advisories and criteria documents to be used in risk assessment procedures. 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 Center for Health Promotion and Preventive Medicine (CHPPM), Edgewood, MD, and the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 255 - Constructed a screening level model of Earth-borne chemical signatures from Unexploded Ordinance (UXO).
- 1968 - Identified toxicity values for use in the ARAMS.
  - Identified biomarkers to assess various toxic endpoints as well as bioaccumulation.
  - Constructed a comprehensive exposure model platform and integrated this module into ARAMS.
  - Identified physical/biological/chemical means by which explosives enter and accumulate in plants and animals (bioaccumulation) in order to develop screening tools and contaminant risk assessment methods.

Total 2223

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

June 2001

BUDGET ACTIVITY

2 - APPLIED RESEARCH

PE NUMBER AND TITLE

0602720A - Environmental Quality Technology

PROJECT

835

## FY 2001 Planned Program

- 376 - Determine effects of relevant environmental parameters of Earth media on UXO chemical signatures.  
- Design predictive tools for UXO multi-contaminant transport processes in various Earth media.
  - 2362 - Construct comprehensive risk assessment model and database modules for explosives and their byproducts to be linked with the ARAMS.  
- Establish effects information to input into comprehensive ARAMS.  
- Construct population model for assessment of environmental effects and link to ARAMS.  
- Link contaminant fate and transport with effects databases for multiple endpoints.  
- Complete design of a comprehensive link between contaminant fate and transport with effects databases for multiple environmental endpoints for incorporation into ARAMS.  
- Enhance the overall performance and real-world simulation of the ARAMS by development of risk assessment prediction methods for whole populations of plants and animals.
  - 84 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 2822

## FY 2002 Planned Program

- 400 - Design a comprehensive model for how the various UXO constituents move and chemically transform through the ground (fate and transport) and prepare this quantitative model for inclusion into the ARAMS.
- 2521 - Complete the determination of how explosives accumulate and enter land-based populations of plants and animals (bioaccumulation) and the reference amounts and rates by which explosives become toxic (toxicity) to marine-based organisms. The specific explosives include: TNT, Royal Demolition explosive (RDX), and High Melting explosive (HMX).  
- Describe the ways and means by which the toxic effects of contaminants are transferred into the human body through the skin (dermal uptake) for ultimate use in the ARAMS.  
- Determine the dynamic mechanisms (kinetics) by which explosives accumulate and enter land-based populations of plants and animals (bioaccumulation) with those factors that determine how toxic the chemicals are to the specified organisms (toxicity).  
- Design a comprehensive predictive model of bioaccumulation and toxicity for site scenarios multiple species of organisms and multiple pathways by which the contaminants can reach the organisms.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602720A - Environmental Quality Technology**

PROJECT

**835**

**FY 2002 Planned Program (Continued)**

- Develop hazard/risk assessment procedures for both land-based and aquatic ecosystems which link exposure, accumulation and the toxic effects of explosives and their byproducts to the organisms.
- Improve the user interface with the ARAMS by the design of a multi-media version.

Total 2921

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602720A - Environmental Quality Technology</b>					PROJECT <b>896</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
896 BASE FAC ENVIRON QUAL	4908	5143	5136	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide technologies to support sustainable use of the Army's training, facilities, lands, and firing ranges. Specific focus is on technologies to reduce or eliminate environmental restrictions on military use of installation facilities, lands, and airspace. Efforts will provide the Army with the technical capability to protect and improve the biophysical characteristics of training and testing areas needed for sustainable ranges and training lands, to accommodate force transformation, and provide support to the Objective Force. Technology developed within this project will enable training and testing facility and land users to match mission events and schedules of training forces employing Future Combat Systems (FCS) to the capabilities of specific land areas, and will also provide advanced methods to restore lands damaged during activities. Technologies will allow operation and maintenance of installation facilities and training range resources in compliance with the myriad of environmental requirements while minimizing threat from stringent environmental laws. Efforts target the development of assessment, monitoring, and modeling capabilities to support risk-based analysis of changes in training doctrine, testing activities and provide for environmentally sustainable land and facilities. The work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4283 - Compared Army-relevant threatened and endangered species (TES) with potentially conflicting mission activities to determine relative risks to species and mission.
    - Developed process-based soil erosion and deposition models that will assist in selecting sites and methods to more effectively reduce the effects of erosion and sedimentation from military activities on training lands.
    - Integrated training distribution, plant species composition, and sedimentation factors that affect land carrying capacity into the Army Training and Testing Area Carrying Capacity (ATTACC) model.
    - Developed a construction demolition debris decision tree for determining recyclability/reusability of structures slated for demolition.
  
  - 625 - Developed activated carbon fiber cloth absorption technologies to control Hazardous Air Pollutants (HAPs) from organic solvents used in Army painting, cleaning, and degreasing operations.
- Total 4908



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602720A - Environmental Quality Technology**

PROJECT  
**896**

**FY 2001 Planned Program**

- 4349 - Validate the use of remote monitoring instrumentation and methods to evaluate changes in animal activity that may be caused by military activities.
  - Incorporate information on the potential of land (soils and vegetation) to be effectively rehabilitated to reduce erosion and sustain land resources into decision support processes for land rehabilitation and maintenance.
  - Develop management and recovery protocols for endangered species that are consistent with an adaptive ecosystem management approach.
  - Develop techniques to spatially link resources and military activity distribution parameters for impact assessment.
  - Identify the proximate effects and protocols to determine effects of smokes and obscurants on endangered species.
  - Investigate impact of contaminated lumber on the recyclability/reusability of deconstructed material.
  - 720 - Develop HAP control technologies for toxic combustion sources.
  - 74 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 5143

**FY 2002 Planned Program**

- 4701 - Establish methodological and statistical protocols for determination of endangered species population viability.
  - Develop protocols for installation-level use of fundamental spatial assessment, cost estimation, and prediction capabilities for ATTACC.
  - Identify adaptive mitigation techniques to reduce constraints on mission activities as a result of endangered species.
  - 435 - Develop new technologies for controlling and/or recycling inorganic HAP emissions.
- Total 5136

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602720A - Environmental Quality Technology</b>					PROJECT <b>F25</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
F25 MIL ENV RESTOR TECH	3180	3540	5554	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide cost effective technologies required to clean up Department of Defense (DoD) hazardous waste sites, including active installations under the Installation Restoration Program, those indicated for closure under the DoD Base Realignment and Closure Program and the Formerly Used Defense Sites Program. Technologies focus on cost-effective and efficient remediation of active training ranges that support enhanced readiness for the Objective Force. The thrust of this effort is to expedite site cleanup, reduce the cost of cleanup of contaminated soil, groundwater, and structures, and ensure that human health and the environment are protected. Research is conducted in several major areas: innovative and cost-effective site identification, characterization, and monitoring technologies, groundwater systems; and treatment technologies to remediate soil and groundwater contaminated with military-unique contaminants such as explosives/energetics, chemical agents, heavy metals, and other organics. Emphasis is placed on the development of in-situ remediation technologies and real or near real-time sensing technologies for Unexploded Ordnance (UXO). Development of existing technologies provides near-term solutions while adding to the knowledge base applicable to successful development of more complex in-situ technologies. The primary developing agency is the U.S. Army Engineer Research And Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3180 - Completed multi-sensor UXO data collection and demonstrated 50% reduction of false alarms at well-characterized UXO test sites.
- Developed engineering approach for delivery of microbiologically nutritional or physical/chemical amendments into the ground for in-situ treatment or for hydrological modifications to groundwater systems to enhance biodegradation and completed bench scale parameter optimization for reactive barrier enhancement.
- Completed vapor-phase biological activity enhancing amendment delivery (proof-of-concept) in soil columns, developed engineering approach for delivery of amendments to the vadose zone, and correlated saturated soil/sediment characteristics with contaminant bioavailability.
- Completed first generation electro-kinetic treatment evaluation for lead and developed prototype instrumentation for on line detection of metal contaminated soils.

Total 3180

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602720A - Environmental Quality Technology**

PROJECT  
**F25**

## FY 2001 Planned Program

- 3435 - Develop predictive models for advanced UXO detection sensors (multi-frequency/multi-channel time domain electromagnetic, Ground Penetrating Radar (GPR), vector magnetic, and seismic/acoustic) and conduct advanced UXO sensor data collection effort at a well-documented site.
    - Conduct first-phase of pilot-scale evaluation of in-situ biodegradation for TNT and in-situ reactive barriers and/or reactive barriers coupled with biodegradation for explosives in groundwater.
    - Conduct evaluation of advanced electro-kinetic treatment technologies for lead and evaluate prototype instrumentation for on line detection of metal contaminated unsaturated soils and groundwater.
    - Investigate aggressive chemical metal treatment alternatives for unsaturated soils and groundwater at small arms training ranges.
    - Evaluate processes for the recycling of metal from contaminated unsaturated soils and groundwater treatment systems with emphasis on electro-kinetic treatment extracts.
  - 105 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3540

## FY 2002 Planned Program

- 656 - Construct predictive tools for UXO multi-contaminant transport processes in various earth media.
  - Design a predictive model to determine explosives toxicity for avian and marine species.
- 2180 - Complete advanced UXO sensor data collection effort at a well documented site.
  - Construct advanced UXO sensor fusion analysis algorithms to be applied to developing UXO detection/discrimination sensing capabilities.
  - Prepare an integrated suite of UXO detection/discrimination multi-sensing and processing modes to be optimized for site-specific environmental characteristics.
- 2718 - Complete first phase of pilot-scale evaluation of in-situ biodegradation for TNT and in-situ reactive barriers and/or reactive barriers coupled with biodegradation for explosives in groundwater.
  - Conduct pilot-scale demonstration of advanced electro-kinetic treatment technologies for lead and of prototype instrumentation for on line detection of metal contaminated soils.
  - Down-select aggressive chemical metal treatment alternatives for small arms training ranges.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602720A - Environmental Quality Technology**

PROJECT

**F25**

**FY 2002 Planned Program (Continued)**

- Evaluate processes for the recycle of metal contaminated extracts for soils treatment systems.

Total 5554

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602782A - Command, Control and Communications  
 Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	19185	23101	24342	0	0	0	0	0	0	0
779 C2 & PLAT ELEC TECH	7569	9735	8095	0	0	0	0	0	0	0
H92 COMMUNICATIONS TECH	11616	13366	16247	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This program element (PE) researches advanced communications technologies and expands scientific knowledge of command and control (C2) and electronics systems/subsystems. The intent is to provide the Army's Objective Force with enhanced capabilities for secure communications and assured information delivery and presentation. This will be achieved by improving the command, control, and communication system (e.g. man-machine interface, mobility, security, capacity, safety, reliability, and survivability) for both air and ground platforms to include the dismounted soldier. Commercial technologies are continuously investigated and leveraged where possible. Research includes the investigation of infrastructures that allow timely distribution, display, and use of C2 data on Army platforms. This research also includes enhancements to the Global Positioning System (GPS) user equipment to minimize registration errors, and improvements to man-machine interfaces and decision aids for a network-centric battlefield environment. This PE will provide Objective Force field commanders the ability to communicate on-the-move (OTM) to/from virtually any location, in a seamless, secure, self-organizing, self-healing, network. Integrated networks of unmanned remote sensors, maneuver and fire support elements, and situational awareness (SA) tools will allow the Objective Force to achieve overmatch with agility and versatility. In addition, portions of the research are directed to supporting the Joint Tactical Radio System (JTRS). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this PE is related to and fully coordinated with efforts in PE 0603006A (Command, Control and Communications Advanced Technology), PE 0602783A (Computer and Software Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), and PE 0603734A (Military Engineering Advanced Technology). The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command (CECOM), Fort Monmouth, NJ.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602782A - Command, Control and Communications  
Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	19519	23314	20796	0
Appropriated Value	19613	23314	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-334	0	0	
c. Omnibus or Other Above Threshold Reductions	-51	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-43	-213	0	
Adjustments to Budget Years Since FY2001 PB	0	0	3546	
Current Budget Submit (FY 2002/2003 PB )	19185	23101	24342	0

Change Summary Explanation: Funding - FY 2002: Additional funds (+5000) were added for command and control on-the-move technology development.

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602782A - Command, Control and Communications Technology</b>					PROJECT <b>779</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
779 C2 & PLAT ELEC TECH	7569	9735	8095	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project researches and applies new concepts and techniques in C2 to achieve new and enhance military functional capabilities. Emphasis is on mission planning, rehearsal, execution and monitoring; precision positioning and navigation; and C2 technologies to support the Objective Force. New enabling technologies that support the current thrusts are also explored, such as advanced displays, multi-modal interactive technology, visualization, decision aids and tactical planning tools, data transfer, distributed data bases, advanced open system architectures, and integration concepts which contribute to more mobile operations. 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: Logistics C2 (Log C2) ATD; Agile Commander ATD; Consistent Battlespace Understanding DTO; Forecasting, Planning, and Resource Allocation DTO; Integrated Force and Execution Management DTO; and Future Command Post Technologies DTO. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1049 - Evaluated Global Positioning System (GPS) enhancement technologies (e.g., advanced filters, low power clocks, advanced antennas) and prepared for the testing and evaluation of these technologies in air and ground platforms. Concluded simulation of navigation system/database registration error minimization.
- 4881 - Matured a common operating environment (COE) compliant 3D visualization capability for the First Digitized Division (FDD); matured a next generation graphics terrain engine for future battlespace visualization applications.  
 - Matured course-of-action (COA) enhancements, including optimization routines and forecasting; transitioned to the Battlespace C2 ATD and the Agile Commander ATD the initial increment of mobile/autonomous intelligent agents to support hasty planning and COA analysis.  
 - Integrated voice recognition and natural language processing (NLP) into the collaboration environment; matured techniques to speed up the donor enrollment process for speech recognition.
- 698 - Integrated a C2 attack simulator with CECOM's Digital Integration Laboratory (DIL) and core distributed interactive simulation (DIS) facilities (CDFs); conducted a distributed simulation to support development and training for integrated C2 protect capabilities.
- 485 - Matured future C2 information and process models in support of the Agile Commander ATD.
- 456 - Matured an experimentation plan and testbed environment to evaluate future C2 needs of tactical commanders from battalion through platoon.

Total 7569

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602782A - Command, Control and Communications  
Technology**

PROJECT

**779**

## FY 2001 Planned Program

- 2050 - Mature and lab-test a real-time prototype of the navigation sensor/database registration error minimization algorithm.
- 2294 - Evaluate improved C2 protect capabilities in a virtual environment to support maturation and training for C2 protect capabilities; integrate brigade and above communications models; conduct a distributed simulation using live troops and multiple sites to support maturation and training for integrated C2 protect capabilities.
- 310 - Mature, adapt and enhance a prototype collaborative logistics planning capability that covers two logistics asset classes and operates within the emerging framework of the Defense Advanced Research Projects Agency's (DARPA) Advanced Logistics Project (ALP).
- 1800 - Conduct laboratory and field experiments with candidate collaborative planning, tactical display, and man-machine interface concepts, built within a portable testbed; evaluate concepts toward feasible solutions for smaller, lighter, energy efficient, and software reprogrammable applications. Concepts will show proof-of-principle improvement in battlespace SA and decision-making processes for commanders from battalion to squad levels
- 2653 - Determine the upper-level knowledge-based interfaces for a distributed analysis and visualization infrastructure for C4I (DaVinci). Specify the initial critical requirements for COA development and analysis, intelligent agents, information visualization, knowledge management, modeling and simulation, and adaptive applications.
- 482 - Conduct flight test evaluation for command, control, communications, computers, intelligence, and electronic warfare (C4IEW) systems.
- 146 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9735

## FY 2002 Planned Program

- 1000 - Conduct lab test and prepare for field test, with a Battle Lab, PM or DARPA partner, to determine the benefit to situation awareness of GPS anti-jam, GPS pseudolite and navigation/electro-optic system integration technologies matured in the preceding two years.
- 1000 - Extend network and information operations security architecture to small unit operations by conducting virtual experiments using the modeling and simulation/stimulation capabilities in the CDFs.
- 1000 - Conduct proof-of-principle evaluation of C2 applications at battalion to squad levels for knowledge-based situational awareness, course of action development, distributed battle planning and visualization, decision support aids, and human-machine interfaces.



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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602782A - Command, Control and Communications  
Technology**

PROJECT

**779**

## FY 2002 Planned Program (Continued)

- 4595 - Mature a task expansion engine as a component within DaVinci to provide low level detail and synchronization data within a COA. Mature intelligent agents to enable linkage of different intelligent agents by action officers and end-users to provide enhanced C2 capabilities. Mature proper provisioning and filtering of information to support the commander in the decision making process.
  - 500 - Conduct flight test evaluation for C4IEW systems.
- Total 8095

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602782A - Command, Control and Communications Technology**

PROJECT  
**H92**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H92 COMMUNICATIONS TECH	11616	13366	16247	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project researches and applies communications and network technologies required to meet the network-centric battlefield needs of the Objective Force, including the dismounted soldier. The strategy is based on leveraging and adapting commercial technology to the maximum extent possible and focusing maturation efforts on those areas not addressed by the commercial industry (e.g. mobile radio based infrastructures and backbones, security in narrowband environments, multiband OTM transmit and receive antennas, adaptive protocols, low probability of interception/low probability of detection). Maximum use is made of the Dual Use Science & Technology (DUST) program. Key areas of research include: adaptation of mobile wireless technologies for hostile mobile environments; quality of service techniques for mobile wireless internet protocol (IP) and IP networks; the adaptation of and interface with commercial personal communications technology leveraging DARPA and commercial technologies for sensor networking; and development of realistic models for emerging communications services systems in dynamic field environments. In addition, this project investigates tactical antenna technologies; photonic controls and ferroelectric materials for phased array antennas; and mobile internet protocols operating across different networks. These efforts directly support the information systems and DTOs outlined in the Defense Technology Area Plan. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4864 - Integrated, assessed, prototyped, tested in testbed, and documented enhanced dynamic resource allocation based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multimedia systems using emulated airborne base stations.
- Integrated, assessed, prototyped, tested in lab testbed, and documented enhanced IP multicasting, IP over asynchronous transfer mode (ATM) multicasting protocols for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers.
- Matured an intelligent IP reachability capability for network management that determines root source of network failures. Transitioned this capability to the Joint Contingency Force (JCF) Brigade Subscriber Node (BSN).
- Designed advanced intelligent modules that inter-operate with fielded network node managers and conducted field-testing.
- Designed very high frequency (VHF)/ultra high frequency (UHF) band for the body borne antenna concept/technologies in support of potential dismounted applications.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE <b>0602782A - Command, Control and Communications          Technology</b>	PROJECT <b>H92</b>
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**FY 2000 Accomplishments (Continued)**

- Matured an extremely high frequency (EHF) OTM satellite communications (SATCOM) antenna self-steering positioner/tracker.
- Identified JTRS multiband OTM antenna prototypes.
- Completed design and initial development of a communications OTM phased array antenna using reduced cost techniques.
- Modeled and simulated photo injection pin diode switch off-state capacitance effects upon the voltage standing wave ratio (VSWR) performance of a structure tuned VHF folded monopole antenna.
- 1791 - Completed transition of virtual simulations and performance transition models to Common Modeling Environment (CME) to facilitate model enhancements for evolving digitized communications in the Objective Force.
- 4961 - Matured protection techniques for the tactical internet with emphasis on malicious code detection and eradication.
- Established a small unit operations/situational awareness system (SUO/ SAS) system environment to support the analysis and evaluation of advanced prototypes.
- Matured future generation dismounted soldier personal communications under DARPA SUO/SAS program. Continued maturation of technology transition strategies to JTRS ground forces domain (handheld and dismounted warrior configurations). Matured a universal handset architecture/design.
- Tested and evaluated advanced wireless mobile networking protocols for dismounted soldier personal communications using laboratory test and field experiment environments. Implemented networking protocols in computer modeling and simulation environment for evaluation of system scalability and performance issues. Demonstrated peer-to-peer and multihop relaying capabilities in laboratory and field experiments.
- Analyzed and evaluated design and engineering approaches for reducing power, weight and size requirements while improving performance of future generation dismounted soldier personal communications.
- Assessed, characterized, and matured DARPA Global Mobile (GloMo) network protocol routing algorithms.
- Identified JTRS software communications architecture for SUO SAS design to support technology transition.
- Evaluated the developmental broadband antennas (800-2500 MHz) for a body borne application to validate modeling and simulation analysis.
- Used modeling and simulation to evaluate specific absorption radiation and gain pattern analysis for body borne antennas.

Total 11616

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE <b>0602782A - Command, Control and Communications          Technology</b>	PROJECT <b>H92</b>
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**FY 2001 Planned Program**

- 5352 - Conduct detailed technical assessment and high level design of mobile agent based dynamic addressing algorithms and protocols, dynamic network constitution and reconstitution algorithms, and protocols for tactical survivable dynamic mixed networks.
    - Design a distributed network management architecture, using intelligent "super agents" for semi-automated end-to-end network management, targeted for the lower Tactical Internet (TI) and Objective Force.
    - Test JTRS multiband OTM antenna prototypes.
    - Complete maturation and evaluation of an X-band subarray. Mature Ka band subarray.
    - Fabricate and test positioner/tracker for EHF OTM low profile antenna.
    - Conduct test of prototype soldier body borne antenna; expand the frequency of low band (20-120MHz) antenna; reduce size and weight of helmet array antenna.
  - 2277 - Conduct sensor communications requirements analysis. Investigate DARPA GloMo and SUO protocols and waveforms for applicability to extreme low power conditions required by unmanned sensor communication networks.
    - Mature architecture and implement Defense Information Systems Agency (DISA) dissemination tools into an Army beta solution.
    - Mature architecture and first order evaluation of adaptive optics for laser communications over 1 mile airpath.
  - 5505 - Evolve protection techniques for the TI with focus on automated security management.
    - Analyze JTRS software communications architecture for SUO/SAS design to support technology transition and complete SUO/SAS technology transition plan.
    - Conduct independent government test and evaluation in laboratory and modeling environments of SUO/SAS engineering models.
    - Validate SUO/SAS RF communications frequency agility, network formation and routing manager functions, modem adaptability, and featureless waveform cover in laboratory environment.
    - Mature wireless radio chip breadboard for application to dismounted soldier interface.
    - Mature personal communication system/ mobile support system (PCS/MSS) breadboard of universal handset technology.
    - Mature broadband body borne antenna and mid-band (250-800 MHz) log periodic dipole array on artificial magnetic conductor substrate.
    - Evolve IP Quality of Service (QoS) implementation to provide multihop wireless communications across dissimilar networks.
  - 232 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 13366

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE <b>0602782A - Command, Control and Communications          Technology</b>	PROJECT <b>H92</b>
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**FY 2002 Planned Program**

- |   |      |   |
|---|------|---|
| • | 5134 | - Evolve and ensure proper operation of the design of the active networks and mobile agent based dynamic re-addressing protocols and algorithms. Conduct analytic modeling, emulation and simulation to fully assess the proposed dynamic re-addressing protocols and algorithms.<br>- Mature an intelligent system that reasons based upon data supplied by mobile agents and security management tools. This will provide the tactical network manager with assistance and suggested courses of action with respect to fault analysis, performance, configuration and security. Target environments are the TI and Objective Force.<br>- Conduct an RF safety assessment of body borne antennas and mature slow wave spiral antenna technologies to achieve antenna size reduction with substantial bandwidth.<br>- Mature a dual beam Ka band phased array antenna; apply thin film ferroelectric and micro electronic mechanical system (MEMS) technologies to reduce phase shifter losses in Ka band phased array antenna. |
|---|------|---|
- |   |      |   |
|---|------|---|
| • | 1674 | - Extend sensor communications architecture to include maneuver layer interoperability including relays and gateways.<br>- Refine sensor communications requirements; integrate protocols and waveforms into prototype hardware.<br>- Conduct early laboratory experiments to establish performance against program goals and evaluation criteria.<br>- Mature a subsystem design for adaptive optics communications. |
|---|------|---|
- |   |      |   |
|---|------|---|
| • | 4439 | - Evolve protection techniques for the tactical internet with emphasis on data mining and security event cross correlation.<br>- Complete JTRS software communications architecture analysis for SUO/SAS design to support technology transition. Upgrade SUO/SAS engineering model units to final prototype configuration and begin independent government test and evaluation in lab and field environments.<br>- Conduct SUO/SAS system-level performance test and evaluation in lab and field environments.<br>- Evaluate wireless radio chip breadboard and conduct lab test for application to dismounted soldier.<br>- Evaluate Personal Communications System (PCS) and Mobile Satellite Services (MSS) breadboard and demonstrate universal handset technology in laboratory environment.<br>- Complete maturation and begin integration of IP QoS into Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) systems architecture. |
|---|------|---|
- |   |      |   |
|---|------|---|
| • | 5000 | - Develop low latency communications for line-of-sight and beyond line-of-sight C2 on-the-move for multi-functional networked manned and robotic platforms. |
|---|------|---|

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602782A - Command, Control and Communications  
Technology**

PROJECT

**H92**

**FY 2002 Planned Program (Continued)**

- Develop three dimensional real time line-of-sight and beyond line-of-sight sensor to shooter LPI/LPD communications network modeling and simulation for manned and robotic vehicle communications to support C2 on-the-move.

Total 16247

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602783A - Computer and Software Technology**

PROJECT  
**Y10**

COST (In Thousands)	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Y10 COMPUTER/INFO SCI TECH	5142	3950	6154	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The problem addressed in this program element is two-fold: 1) Current collaboration for decision making (planning and execution) is a manual process, not synchronized, sequential and slow, and 2) collaboration tools support the staff, not the Commander. Technical barriers to the accomplishment of this program include the non-existence of automated tools to support the flow and synchronization of data/information from humans to humans, from humans to computers, from computers to humans, as well as the fact that automation is currently too dependent on mouse and keyboard versus other modes of communication and understanding. The goal of the program element is to research and apply information and communications technology to enhance understanding and speed the decision cycle for commanders operating in the mobile dispersed environment envisioned for the Objective Force. Efforts capitalize on computationally intensive approaches that exploit the rapidly evolving capabilities of emerging information and communication technology to create innovative military capabilities so as to yield a significant and real military advantage on the battlefield. Focus is on providing general solutions that can be applied to a wide variety of command and control (C2) problems. Work in this project is conducted by the U.S. Army Research Laboratory, and is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3726 - Conducted experiments on distributed and collaborative group support environment in concert with Army Battle Labs.
- Modified collaborative tool set capabilities based on evaluations by the Battle Labs.
- Incorporated multimodal interfaces into collaboration tools to facilitate operations on the move (from Advanced Displays and Interactive Displays (ADID) Federated Laboratory Program).
- Incorporated course of action development and analysis tools (from ADID Federated Laboratory Program) into collaboration tools.
- Incorporated low bandwidth technology for Video Teleconferencing (VTC) from ADID Federated Laboratory program into collaboration tools to bring capability down to dismounted commander.

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

June 2001

BUDGET ACTIVITY

2 - APPLIED RESEARCH

PE NUMBER AND TITLE

0602783A - Computer and Software Technology

PROJECT

Y10

## FY 2000 Accomplishments (Continued)

- Described 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, generate active database triggering mechanisms that prioritize data packages to be sent.
- Translated computer-generated broad courses of action (COA) into input scenarios for the Army's current warfighting simulation of choice and performed preliminary analysis on outcomes, for evaluation of man- or machine- generated future Objective Force COA's integrated collaboration technologies and transitioned to CECOM.
- Integrated collaboration technologies and transitioned to CECOM.
- 1416 - Evaluated performance of mobile ad hoc network algorithms and self-configuring mobility protocols that support secure multicast streaming for mobile wireless nodes.
- Integrated video streaming for mobile wireless nodes.
- Evaluated performance of energy-efficient, self-configuring, ad hoc routing and medium access control algorithms that supports unattended ground sensors.
- Evaluated performance of automated vulnerability assessment tools that perform continuous assessments of bandwidth-constrained mobile wireless networks and identifies a set of known configuration errors and susceptibilities.

Total 5142

## FY 2001 Planned Program

- 2499 - Conduct Battle Lab experiments with second-generation collaborative technologies in order to identify and address technology gaps.
- Integrate intelligent agent technologies that off-load routine tasks from the warfighter into collaboration tools in order to identify and quantify benefit to warfighter's decision making process.
- Utilize metrics for display design (developed in ADID Federated Laboratory) to enhance assimilation of information by commanders operating in a distributed environment - impact will be quantified.
- Measure and evaluate performance improvement of information management algorithms responding to network delay feedback.
- Conduct experiment to empirically measure processing overhead due to intranet routing protocols and compare to simulation results in order to identify most efficient protocol structures.
- Provide upgraded collaboration technology modules to CECOM's Agile Commander Advanced Technology Demonstration (ATD).
- 1362 -Enhance performance of mobile ad hoc network algorithms and protocols integrated with self-configuring mobility protocols that support secure multicast streaming for mobile wireless nodes.



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

June 2001

BUDGET ACTIVITY

2 - APPLIED RESEARCH

PE NUMBER AND TITLE

0602783A - Computer and Software Technology

PROJECT

Y10

## FY 2001 Planned Program (Continued)

- Evaluate mobile ad hoc network algorithms and protocols integrated with self-configuring mobility protocols that support secure multicast streaming for mobile wireless nodes.
- Enhance energy-efficient, self-configuring, ad hoc routing and medium access control algorithms integrated with localization algorithms that support unattended ground sensors.
- Enhance automated vulnerability assessment tools with the capability to perform directed assessments of bandwidth-constrained wireless networks to confirm the existence of a set of known configuration errors and susceptibilities.
- Transition communications technology to CERDEC in support of FCS-related ATDs.
- 89 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3950

## FY 2002 Planned Program

- 4154 - Evaluate and refine collaborative planning tools in support of evolving Objective Force command and control process, conduct and document the usability through experiments at TRADOC Futures Battle Lab and Agile Commander ATD.
  - Assess technologies for a low power, miniature radio that can be integrated in a miniature sensor to create a secure network to support forward-deployed unattended munitions, sensors and robotic prototype radio with integrated network protocols.
  - Define the requirements for a common network architecture for unattended sensor arrays, assess candidate protocols for very short duty cycle networks that use low power radios to control and transmit data from sensors, smart munitions and robots.
  - Provide mobile code for protecting tactical wireless networks, allowing Commanders to operate in a dynamically configurable environment.
  - Explore encryption algorithms and protection techniques for microsensors to reduce the vulnerability of unattended sensors arrays on the tactical battlefield.
  - Research various techniques that merge real time battlespace data to simulate proposed courses of action providing advantage and disadvantage insight of alternatives.
- 2000 - Communications and Networks Collaborative Technology Alliance development of next generation automated intrusion detection techniques that accommodate wireless, self-configuring, mobile ad hoc networks and adapt to varying resource constraints.
  - Communications and Networks Collaborative Technology Alliance development of denial-of-service mitigation techniques for wireless networks with mobile network routers.

Total 6154

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602783A - Computer and Software Technology**

PROJECT  
**Y10**

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	5173	3987	4141	0
Appropriated Value	5210	3987	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-131	0	0	0
c. Omnibus or Other Above Threshold Reprogramming	-20	0	0	0
d. Below Threshold Reprogramming	100	0	0	0
e. Rescissions	-17	-37	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	2013	0
Current Budget Submit (FY 2002/2003 PB )	5142	3950	6154	0

Change Summary Explanation: Funding - FY 2002: Funding added (+2000) to develop next generation information assurance for the Army's future tactical wireless networks.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	46886	55332	42850	0	0	0	0	0	0	0
855 TOP,IMAGE INTEL&SPACE	9286	9611	9795	0	0	0	0	0	0	0
H71 ATMOSPHERIC INVESTIG	6051	6304	5997	0	0	0	0	0	0	0
T40 MOB/WPNS EFF TECH	14781	15392	15781	0	0	0	0	0	0	0
T41 MIL FACILITIES ENG TEC	3936	4165	4498	0	0	0	0	0	0	0
T42 COLD REGIONS ENGR TECH	5157	5200	3932	0	0	0	0	0	0	0
T45 ENERGY TEC APL MIL FAC	2425	2771	2847	0	0	0	0	0	0	0
T46 CLIMATE CHANGE FUEL CELL TECHNOLOGY	2386	0	0	0	0	0	0	0	0	0
T49 UNIVERSITY PARTNERING FOR OPERATIONAL SUPPORT	2864	3963	0	0	0	0	0	0	0	0
T52 DOD FUEL CELL TEST AND EVALUATION CENTER	0	4954	0	0	0	0	0	0	0	0
T53 THERMOELECTRIC POWER GENERATION FOR MILITARY APPS	0	2972	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE:** This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

The objective of this program element (PE) is to provide technologies in direct support of critical warfighter functions of mobility, countermobility, survivability, sustainment engineering, and topography needed to transform the force. Research is conducted that supports special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Key operational science & technology is provided to Army units under PE 0603734A (Military Engineering Advanced Technology). Results are tailored to support the materiel development, test, and operations communities in evaluating the impacts of weather, terrain, and atmospheric obscurants on military operations. Research provides and exploits a wide range of innovative technologies and applies them to Defense unique planning, acquisition, revitalization, and sustainment processes. This research will improve the efficiency and cost effectiveness as it relates to supporting the training/readiness/force projection missions in garrison and force sustainment missions in theaters of operation. The work in this PE is aligned with the Army's vision for the Objective Force and adheres to Defense Reliance Agreements on Civil Engineering and Battlespace Environments with oversight provided by the Joint Directors of

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

Laboratories and Joint Engineers. The cited work is also consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. The PE contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center (ERDC) and the U.S. Army Research Laboratory.

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	47639	42344	44571	0
Appropriated Value	47885	55844	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-583	0	0	
c. Omnibus or Other Above Threshold Reductions	-90	0	0	
d. Below Threshold Reprogramming	-170	0	0	
e. Rescissions	-156	-512	0	
Adjustments to Budget Years Since FY2001 PB	0	0	-1721	
Current Budget Submit (FY 2002/2003 PB )	46886	55332	42850	0

In FY01, Congressional adds were received for (T52) DoD Fuel Cell Test and Evaluation Center (\$5000), (T42) Cold Regions Base Camps (\$1500), (T49) University Partnering for Operational Support (\$4000) and (T53) Thermoelectric Power Generation for Military Applications (\$3000).

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602784A - Military Engineering Technology**

No additional funds are required to complete these projects.

- (\$5000) DoD Fuel Cell Test and Evaluation Center to demonstrate and validate fuel cell technology for military and commercial applications.
- (\$1500) Cold Regions Base Camps continues research supported by previous Congressional adds to investigate impacts of cold environments on Objective Force capabilities.
- (\$4000) University Partnering for Operational Support continues research supported by previous Congressional adds that enhances operational, fine-scale forecast models of basic meteorological variables.
- (\$3000) Thermoelectric Power Generation for Military Applications to investigate use of thermoelectric technology to recover energy from boiler and industrial exhaust streams.

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602784A - Military Engineering Technology</b>				PROJECT <b>855</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
855 TOP,IMAGE INTEL&SPACE	9286	9611	9795	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to develop technology that will help those who move, shoot, and communicate on the battlefield to "fight smarter" through superior knowledge of the total battlefield terrain and environment. 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 enhance the tactical commander's lethality, survivability, and mobility capabilities through the exploitation of combat relevant intelligence as a force multiplier to conduct and win operations with a smaller, lighter, and more agile force. Information dominance is a critical technology enabler for the Objective Force; Future Combat Systems (FCS); and Army Vision, Joint Vision 2020 concepts. Using tactical/strategic/space sensor data, together with terrain data bases as input, the technology program emphasizes automating the processes of detecting change 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. Work in this project significantly enhances the Army's geospatial data management and dissemination capabilities by providing advanced technologies for storing, transforming, updating and disseminating extremely large volumes of terrain data at, or near, real-time. Weather/atmospheric effects data is provided for this project by the U.S. Army Research Laboratory project H71 in this program element. This project is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 9286 - Incorporated automated feature extraction techniques from spectral, synthetic aperture radar and electro-optical sources into the digital stereo photogrammetric workstation to improve the accuracy and time required to create digital databases.
- Demonstrated a capability to manage, disseminate and integrate topographic point, line and area feature data using advanced on-line warehouse technology.
- Extended physics-based models and visualization capability to passive and active millimeter wave for target acquisition.
- Completed design of a concept model for a low cost wheeled vehicle tactical navigator for improved battlefield positional capability.
- Identified performance baseline criteria and completed initial design of appropriate spectral/spatial algorithms for terrain characterization.

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602784A - Military Engineering Technology**

PROJECT

**855****FY 2000 Accomplishments (Continued)**

- Developed and implemented a thorough test and evaluation protocol for algorithms used to generate slope information from elevation data.

- Delivered validated terrain analytics to Joint Terrain Analysis Tool (JTAT) and reengineered tactical decision aids to Combat Terrain Information System (CTIS).

Total 9286

**FY 2001 Planned Program**

- 9445 - Develop capability for automated feature attribution using knowledge-based rules to provide better knowledge of the battlefield for FCS and the Objective Force.
  - Extend advanced geospatial data management technology to support rapid update of terrain information using best available sources.
  - Integrate model derived from infrared and millimeter wave sensor performance overlays into 3D visualization for enhanced visualization of theater characteristics.
  - Complete implementation of spectral/spatial algorithms for detection and identification of terrain features and conditions.
  - Extend the spatial analysis tool to support course of action analysis for ground order of battle.
  - Deliver enhanced analytical terrain-reasoning tools to Army Battle Command System's All-Source Analysis System (ASAS) and CTIS.
  - Build concept model of a low cost wheeled vehicle tactical navigator and assess when available for improved battlefield vehicle position/navigation (POS/NAV).

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

Total 9611

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**855**

## FY 2002 Planned Program

- 9795 - Develop initial terrain reasoning capability to provide time-sensitive course-of-action information for Objective Force applications.
  - Develop improved geospatial data access and distribution tools for more efficient dissemination of digital data.
  - Implement 3D dynamic multi-spectral synthetic scene into force-on-force simulation.
  - Develop prototype of a low cost wheeled tactical navigator for improved battlefield vehicle POS/NAV.
  - Integrate new multi-sensor exploitation software into the digital stereo photogrammetric workstation for quicker and more efficient digital database construction.
  - Develop prototype for common environment database repository resulting in one integrated database for mission planning and rehearsal, modeling and simulation and common operating picture of the battlefield.
  - Complete spatial analysis software to support course of action analysis for ground order of battle.
  - Prototype rapid distributed data insertion software to tactical units for increased situational awareness to improve capability to provide time-sensitive course-of-action information.
  - Develop data exploitation software for new data sources to improve analysis of time-sensitive geospatial information.

Total 9795



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**H71**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H71      ATMOSPHERIC INVESTIG	6051	6304	5997	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to perform the applied research for tactical weather and atmospheric effects algorithms, and for the integration of battlefield atmospheric environments simulations. The Army's transformation plan to the Objective Force will require capabilities for battlefield commanders to make decisions based on tactical weather technology and impacts. This weather intelligence data will have to be not only accurate and timely, but distributed down to the lowest levels of command, which may include the individual soldier. This project accomplishes this mission by transitioning technology to the Project Director Integrated Meteorological System (PD-IMETS), through support to the Program Manager for Night Vision/Reconnaissance Surveillance and Target Acquisition (PM-NV/RSTA) for field artillery systems, and to the Department of Defense (DoD) modeling community. It provides the weather data from forecast/nowcast models, the distributed 4D weather database, and the weather decision aids that use this data for the digital battlefield commander by applying advanced computer techniques; incorporating new technology in meteorological sensor and system designs; researching data fusion techniques to horizontally integrate data from advanced weather sensors and non-weather sensors into decision aids for enhanced combat power on the battlefield and enhanced effectiveness of field artillery and deep attack assets. This project supports the Army's transformation to the Objective Force through future applications and platforms that support echelons at Brigade and below, down to the individual soldier, and Defense Technology Objectives, Weather/Atmospheric Impacts on Sensor Systems, and On-Scene Weather Sensing and Prediction Capability. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 6051 - Completed improved numerical weather prediction and high resolution forecast modeling capabilities to enhance the assessment of environmental effects on operations.
  - Delivered integrated IMETS applications to PD-IMETS and prepared version for inclusion into Army Battle Command System (ABCS) 6.1 for demonstration in Joint Contingency Force exercise including weather data visualization, rule-based and physics-based weather impact models as client applications that provides an interactive capability for Battlefield Functional Area C4I systems to retrieve data on demand from IMETS meteorological databases.
  - Modified current smoke models to generate 3D smoke fields for simulations, virtual testing, and analysis.
  - Completed a preliminary neural network method for retrieval of wind profiles from meteorological satellite sounder data that, when validated and implemented, will allow near real-time wind data to be obtained over target areas for more effective use of smart munitions and submunitions.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602784A - Military Engineering Technology**

PROJECT

**H71**

## FY 2000 Accomplishments (Continued)

- Delivered Meteorological Kernel (firing table) software with documentation to the ARDEC for enhanced fire support effectiveness.
- Completed installation of model software on a computer at the ARL High Performance Computer facility for verifying the capability of the Army's Battlescale Forecast Model (BFM) to forecast weather hazards in the lowest levels of the atmosphere through comparison with two university weather prediction models and with current Navy and Air Force larger scale models.
- Completed a preliminary combined temperature retrieval method that uses data from a ground-based microwave radiometer and meteorological satellite sounders for more accurate remotely sensed temperature soundings along a projectile trajectory.
- Incorporated Acoustic Battlefield Aid (ABFA) output over a 3D terrain for high-resolution acoustic target acquisition calculations.

Total 6051

## FY 2001 Planned Program

- 6249 - Integrate joint weather impacts into decision aids for the Army's First Digitized Division weather capability.
  - Upgrade Weather Impact Decision Aid models with the characteristics and the impacts of weather on threat platforms, weapons, sensors and operations to forecast the deltas between threat and friendly systems.
  - Complete a 3D atmospheric propagation and simulation model that includes the effects of absorption, scattering, and radiative transfer, turbulence, clouds, aerosols, and smoke for improved simulations, virtual testing and analysis.
  - Expand the EOSAEL model suite with an acoustics model, complete with documentation, for improved military analysis studies and wargames.
  - Incorporate turbulent scattering into scanning acoustic wave propagation models for enhanced acoustic target acquisition.
  - Couple Acoustic Battlefield Aid (ABFA) with an Acoustic Target Recognition database and quantify the impacts on prediction of sensor performance.
  - Conduct verification and validation of neural network method for retrieval of wind profiles from met satellite sounder data and integrate combined temperature retrieval method to prototype MMS-Profiler processors to achieve better temperature sounding capability for improved artillery accuracy.
  - Conduct verification and validation of BFM modules for critical target area forecast parameters such as temperature, wind speed and wind direction, that will lead to more effective use of smart munitions and sub-munitions in the target areas.
- 55 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 6304

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**H71**

**FY 2002 Planned Program**

- 5997 - Incorporate full complex terrain/turbulent scattering acoustic propagation model into next generation weather decision aid systems.
- Evaluate polarimetric imaging techniques for incorporation into sensor platforms for the Future Combat Systems (FCS).
- Modify the BFM to accept weather data from local and RSTA sensors for improved meteorological information collection and utilization.
  
- Evaluate techniques for effectively compressing meteorological data for distribution over low bandwidth networks.
- Investigate methods for delivering meteorological information to FCS in compressed form to conserve limited bandwidth.
- Investigate weather effects software to provide accurate artillery-tailored weather effects decision aids for trajectory analysis, targeting, and go/no-go forecasts to the fire control databases.
- Evaluate non-hydrostatic mesoscale forecast model for more accurate battlefield moisture forecasts.
- Verify the new Cumulus Parameterization Scheme for estimating convective precipitation for transition into IMETS and field artillery meteorological models.
- Assess utility of prototype fluorescent particle sensor as part of a sensor suite for hazard detection and identification.
- Prepare an on-scene weather nowcast capability that can integrate ground-truth weather observations from non-conventional meteorological sensors such as Unmanned Aerial Vehicles (UAV), surface observations, and robotic sensors, with the current long-term forecasts generated at higher echelons to provide full spectrum weather support to the Army's Objective Force.
- Prepare distributed weather client applications for push/pull of forecasts and weather impact decision aids to lower echelons of the Objective Force, including Brigade Combat Weather Teams and soldier level interactive displays.

Total 5997

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**T40**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T40 MOB/WPNS EFF TECH	14781	15392	15781	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide technologies for prediction and mitigation of coastal effects on logistics-over-the-shore (LOTS) operations; rapid construction and repair of forward airfields; rapid establishment and repair of lines of communications; and expedient protection of forward deployment operations. These technologies directly support the Chief of Staff of the Army's initiative to transform the Army into a more responsive, deployable, agile, versatile, lethal, survivable, and sustainable force. The research focuses on technologies that support the deployment of a brigade in 96 hours, a division in 120 hours, and five divisions in 30 days. The research provides technologies that assist in the development of the Future Combat Systems (FCS) by accurate assessment of battlefield mobility for materiel developers during virtual prototyping; and factual representation of mobility, obstacle and barrier creation, survivability, and weapons effects in future modeling and simulation in force development and training. The research will provide technologies that will increase the survivability and sustainability of deployed forces, while reducing their logistical footprint. This will allow them to be more responsive, deployable, and agile through material and technique development for expedient base camp and theater missile defense protection; camouflage, concealment, and deception by signature manipulation; terrorist protection from asymmetric threats; and breaching for Military Operations in Urban Terrain operations. The work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 13839 - Identified infrared signature manipulation techniques for use in expedient decoy construction; developed protective concepts for key assets in forward logistic nodes.
  - Derived methodologies to provide lighter, more survivable protection by predicting down axis ground shock from detonation partially above and in burster slab; developed and validated methods for retrofitting walls to resist terrorist mortars from an asymmetric threat.
  - Completed first version of Coastal Integrated Throughput Model to ensure more reliable assessment of force projection and sustainment throughput; developed methodology for hydrologic modeling of watersheds worldwide to enable more accurate assessments of maneuver/counter maneuver options in training/operational exercises.
  - Analyzed methodologies for making short-term forecasts of soil strength based on predicted weather changes for more accurate assessment of mobility requirements for the FCS.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**T40**

**FY 2000 Accomplishments (Continued)**

- Integrated Improved Bridge Assessment Rehabilitation and Repair (IBARR) software with road assessment algorithms; established criteria for off-road/bypass evaluation around damaged road networks for increased situational awareness.
- Used physics-based models to incorporate multiple-wheel interaction and rate dependent response analysis into an advanced pavement analysis model that will accurately assess airfield and LOC performance for reliable throughput predictions.
- Initiated contract to test and evaluate the Computer Aided Earthmoving System to enable rapid airfield construction necessary for current force projection requirements.

- 942 - Developed software containing selected infrastructure and initial damage predictions from a terrorist attack.

Total 14781

**FY 2001 Planned Program**

- 14307 - Develop analytical prediction methodology for forced-entry design criteria; evaluate protective concepts for base clusters and forward logistic nodes.
  - Select analytic methodologies to provide lighter, more survivable protection by predicting down-axis ground shock from detonation partially in and below burster slab; complete dynamic experiments and analyses for enhanced survivability using square concrete structural components with intermediate span to thickness ratios; develop methods for retrofitting roofs to resist terrorist mortars from asymmetric threats.
  - Complete second version of Coastal Integrated Throughput Model and validate improved, robust basin delineation computer sub-routines in a tactical planning exercise.
  - Derive operational unit level movement algorithms for rapid, accurate and reliable representation of future force maneuver in Army models and simulations.
  - Develop rapid construction, maintenance, and repair techniques and materials for roads and bridges to enable rapid force projection, and develop physics-based damage models to predict roadway damage from future vehicle interactions during rapid force projection.
  - Incorporate fracture concepts into the pavement performance model; incorporate realistic performance/damage concepts into the advanced pavement analysis model to ensure accurate and reliable damage assessments on airfields during rapid force projection.
  - Finalize test and evaluation of Computer Aided Earthmoving System for initial assessment of rapid airfield construction capability.

- 1000 - Add capability to the vulnerability assessment software to predict damage from an asymmetric terrorist attack to a selected infrastructure.

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

Total 15392

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**T40**

**FY 2002 Planned Program**

- 14781 - Provide ballistic and low-signature protection for base camps, increasing their survivability from weapons threats; provide database structure and building wizard for regional-specific material properties and construction practices suitable for vulnerability assessments.
  - Develop validated techniques to provide lighter, more survivable protection by predicting ground shock and structure-media interaction for square structures with length/thickness ratio of 5; develop analytic methodology to predict ground shock range to effect from fully coupled detonation in limestone; develop procedures to assess the vulnerability of structures used by deployed forces and methods to reduce blast stand-off distances from terrorist weapons.
  - Determine mobility performance requirements for advanced vehicle platforms such as FCS.
  - Evaluate hydrology model for effect/assessment on maneuver/counter maneuver during rapid force projection in worldwide scenarios.
  - Complete coastal throughput assessment for rapid force projection and sustainment operations for a particular theater of operations.
  - Develop methods for evaluating the effects of weather on engineer effort in rapid repair/construction of roadways during future force projection and sustainment operation scenarios.
  - Develop residual strength assessment methodology for assessing bridges to increase the situational awareness for the Objective Force.
  - Complete development of advanced pavement design and analysis model for rapid, accurate and reliable prediction of airfield performance using current and future aircraft.
  - Assess materials and methods for rapid airfield construction that emphasize speed of construction and reliability of performance with a reduction in logistical tail during construction and maintenance of airfields.
  - Incorporate cross-beach Coastal Integrated Throughput Model into improved mobility models for accurate assessment of maneuver and throughput during rapid force projection and sustainment operations.
- 1000 - Complete development of vulnerability assessment software for protection of the selected critical infrastructure from asymmetric terrorist attacks.

Total 15781

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602784A - Military Engineering Technology</b>				PROJECT <b>T41</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T41 MIL FACILITIES ENG TEC	3936	4165	4498	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide technology necessary for efficient and effective facilities and installation operations required to support the Objective Force in its evolving mission. The project focuses on advanced technologies for the continuum of facilities and operations by assuring cost efficient and effective infrastructure and processes for training, readiness, power projection, and forward basing. These innovative developments also achieve a critically needed cost reduction in the Army facility life cycle process (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal), and the supporting installation operations. Additionally the improved facility quality provided by this work improves soldier quality of life and enhances soldier retention. Examples of innovative technologies evolving from this work include composite rehabilitation materials, concurrent engineering, collaborative decision support, multi-hazard mitigation, knowledge processing and electromagnetic shielding. 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 U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3826 - Developed advanced structural integrity monitoring algorithms to provide information for assessing structural health, safety and remaining service life.
- Modeled corrosion degradation mechanisms for coated steel.
- Characterized diaphragm design deficiencies in existing Army buildings under earthquake loading.
- Developed analytical model and improved seismic design guidance with anchor details for cold-formed steel.
- Improved facility life cycle processes provided by Modular Design System.

Total 3826

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602784A - Military Engineering Technology**

PROJECT

**T41****FY 2001 Planned Program**

- 4130 - Complete development of an integrated corrosion control selection guide for selecting and using corrosion control materials and technologies.
  - Develop predictive service life tests and criteria for roofing membrane materials.
  - Complete final building composer integrated with the collaborative mechanisms of the "Totally Integrated Project Delivery" framework.
- 35 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 4165

**FY 2002 Planned Program**

- 4498 - Complete seismic vulnerability evaluation guidance for building diaphragms in Army facilities.
  - Develop a prototype model to apply process driven rational approach of reliability-centered maintenance for Army infrastructure.
  - Conduct integration tests and develop methodologies utilizing model-based engineering processes for the facility life cycle.

Total 4498



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**T42**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T42 COLD REGIONS ENGR TECH	5157	5200	3932	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project is the only Department of Defense (DoD) applied research effort focused on the knowledge base and engineering principles for achieving Objective Force capabilities in seasonal conditions and in cold regions of the world. The Objective Force and Future Combat Systems (FCS) must have expert knowledge of the battlespace environment to obtain desired lethality, survivability and mobility. Advances in sensing and target acquisition capabilities critical to FCS require greater fidelity and more accurate forecasts of state of the terrain. Research provides the basis for extending the operability of the Objective Force in all seasons through application of physics-based models for predicting state of the terrain, and the effects of the environment on target and target background signatures. To achieve superior mobility and enable required strategic, operational, and tactical maneuver in all seasons, the Objective Force requires non-materiel advances in military engineering capabilities. Research provides for advances in planning and assessment tools, innovative construction materials, and techniques and procedures to reduce dependence on ports and airfields. The work is managed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 5157 - Formulated an integrated seismic/acoustic signature simulation model that will generate acoustic and seismic signatures for heavy tracked and wheeled vehicles in a variety of terrains.
- Confirmed application of physics-based models and visualization to support weapons selection and mission rehearsal for weapon systems equipped with infrared targeting sensors.
- Provided winter climate index characterization manual for snow and soil freezing effects.
- Originated model for predicting the effect of moisture and temperature gradients on pavement strength and roughness during freezing and thawing for airfields and pavements in cold regions.
- Enhanced technologies for forecasting winter/seasonal impacts on Objective Force logistics and mobility.

Total 5157

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**T42**

## FY 2001 Planned Program

- 5159 - Characterize the geophysical properties at Yuma Proving Grounds Smart Weapons Test Range with geophysical testing techniques and run corresponding computer simulations to verify accuracy of simulated seismic signal levels for non-moving impulsive loads.
  - Integrate multispectral (infrared and millimeter wave) sensor performance products into 3-dimensional (3D) terrain visualization.
  - Advance innovative thawed soil stabilization techniques for base camps and expedient roadways in austere/remote theaters.
  - Incorporate the freeze-thaw model into the 3D finite element pavement model in order to predict pavement performance during freeze-thaw periods.
- Apply high fidelity vehicle dynamics modeling capability for development of seismic source signatures.
- 41 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5200

## FY 2002 Planned Program

- 3932 - Use DoD high performance computing resources to perform a seismic simulation sensitivity study of ground vibrations propagating from armored vehicles moving over a variety of terrains and geologic settings, and use results of the study to verify accuracy of seismic simulations in comparison to field test results of moving tracked vehicles.
  - Implement 3D dynamic multi-spectral synthetic scene visualization capability in mission planning, training, and weapon selection tools through the Digital Topographic Support System.
  - Modify Theater Infrastructure Planning and Assessment Model with effects of frost heave, thaw weakening, and snow and ice accumulation planning algorithms to optimize the prioritization and scheduling of maintenance and repair resources.
  - Complete mechanistic model for pavement design and evaluation to prevent/alleviate frost heave and thaw weakening, thermal cracking, and cracking induced by structural loading during thaw periods.
  - Develop high fidelity model for prototype wheeled vehicle performance evaluation on a dynamic surface (alterable friction coefficients representing snow and ice conditions).

Total 3932

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602784A - Military Engineering Technology**

PROJECT  
**T45**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T45 ENERGY TEC APL MIL FAC	2425	2771	2847	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to provide technology necessary to provide cost effective, energy efficient, sustainable military installations during the dramatically changing energy picture (i.e., deregulation) and the Army transformation to the Objective Force. Advanced energy technologies and processes are also applied to the Army's industrial base to maintain its cost-effective readiness. Examples of the advanced technologies include integrated distributed and renewable energy supply, hybrid cooling; and microturbines for Army application at all installations, to include theater of operations. Under the Department of Defense (DoD) Project Reliance initiative, the Army is responsible for managing the conventional facilities research and development needs of all the military services through the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2425 - Completed investigation of electrical, gas and cooling screening, design and application tools for development of hybrid cooling systems.
- Developed methodology for integrated long-term utility and energy planning initiatives for Army installations.
- Completed automated procedures for heat system inventory, inspection, condition assessment, and condition prediction for systematic maintenance and repair of heat distribution systems.

Total 2425

**FY 2001 Planned Program**

- 2752 - Complete process for maintaining technology for improving energy system performance for building energy systems.
- Automate selection/design practice for hybrid cooling systems.
- Complete process energy and pollution reduction (PEPR) program with expert system capability.
- 19 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2771

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602784A - Military Engineering Technology**

PROJECT

**T45**

## FY 2002 Planned Program

- 2847 - Develop air pressure leak management techniques for modernizing Army compressed air systems.
- Determine the number and types of verification processes necessary to validate the full range of Army energy projects.

Total 2847

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602785A - Manpower, Personnel and Training</b> <b>Technology</b>						<b>PROJECT</b> <b>790</b>	
COST (In Thousands)	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
790 PERSONNEL PERFORMANCE & TRAINING TECHNOLOGY	11770	11759	16315	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The objective of this program element (PE) is to provide the scientific and technical basis for personnel selection, leader development, and training for Future Combat Systems and the Objective Force. This applied research program will provide advanced tools to improve the selection and classification procedures to ensure the right person is placed in the right job, determine leader skills and requirements, and provide the behavioral technologies required for the development of effective individual and collective (unit) training strategies. Research topics include training strategies for the digitized battlefield, training strategies in simulated environments, optimum designs and utilization of simulators and training devices to achieve maximum learning at minimum cost, and modernization of the selection and classification systems to maintain warfighting capabilities for future forces. 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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 11770 - Developed and validated a situation awareness measurement instrument for use by small Infantry units.
- Completed research on the implementation and assessment of specific Force XXI Training Programs with selected Army units, providing TRADOC with methods and techniques for development of training support packages; and the TRADOC System Manager for the Combined Arms Tactical Trainer with information to support acquisition of simulators and performance assessment systems for digital training.
- Determined factors influencing propensity of soldiers completing Initial Entry Training for service completion.
- Developed, demonstrated and evaluated instructional modules for versatile thinking in command (focus on brigade staff functions and tasks).
- Identified computer skills possessed by the typical Infantry soldier and leader as of FY99, for use by the Infantry School in determining training requirements for the Land Warrior Soldier System.
- Implemented and evaluated instructional feature and training strategy enhancements to the Military Operations in Urban Terrain (MOUT)/ contingency operations trainer, including an intelligent tutoring system.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602785A - Manpower, Personnel and Training  
Technology**

PROJECT

**790**

## FY 2000 Accomplishments (Continued)

- Identified the role of simulation devices, instructors, and instructional processes in a model simulator-training program for Initial Entry Rotary Wing (IERW) flight training.
- Documented lessons learned from ARI research on rifle marksmanship training and performance.
- Developed cooperative program of flight simulation training research with Aircrew Training Division of Air Force Research Laboratory.
- Assessed effectiveness of preliminary M2A3 Bradley Fighting Vehicle training programs and training devices.
- Implemented and evaluated innovative training of thinking skills at the Command and General Staff College.
- Developed prototype Non-Commissioned Officer (NCO) performance measures for the Objective Force.
- Developed an electronic index of databases on youth and parent attitudes relevant to Army recruiting.

Total 11770

## FY 2001 Planned Program

- 11509 - Identify potential training issues emerging from the Initial Brigade Combat Team (IBCT) that are relevant to the Future Combat Systems (FCS).
  - Develop, demonstrate, and evaluate extended instructional modules for versatile thinking skills required by division staff.
  - Field test small unit leader situational awareness measurement instruments.
  - Determine simulator training task requirements for future Army aircraft.
  - Incorporate prototype system for computer recognition of human gestures into Virtual Environments for dismounted soldier training and mission rehearsal.
  - Determine the relationships between 21st century NCO attributes and mission performance measures to identify the best predictors of success.
  - Assess effectiveness of virtual environment interface improvements for training and mission rehearsal.
  - Recommend procedures to enhance transfer of performance across upgrades of digital systems.
  - Describe changes in unit behavior associated with digitization.
- 250 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 11759

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602785A - Manpower, Personnel and Training  
Technology**

PROJECT

**790**

## FY 2002 Planned Program

- 13315 - Implement and evaluate VE-based training system enhancements such as improved locomotion and visual systems, and voice and gesture control of simulated subordinates.
  - Complete transfer of training research on simulator-based training for the contact phase of IERW flight training.
  - Identify and select critical FCS C4ISR collective tasks and develop appropriate experimental battle scenarios.
  - Develop and validate computer-based training alternatives for mastering selected, critical computer skills that will enable operators to maintain situation awareness in a situation that simulates the pressures of a field environment.
  - Determine the best indicators of future NCO performance.
  - Identify impact of "Think Like a Commander" training on tactical performance.
  - Validate determinants of the individual characteristics, job experiences, and organizational factors predicting service attrition and completion.
  
- 3000 - Validate potential new screening measures against station commander and recruiter performance.
  - Design techniques for measuring and enhancing self awareness and adaptive leadership.
  - Continue analyses of leader predictors and plan follow-on longitudinal data collection of USMA Class of 1998 field leadership experience and skills.
  - Expand database to include other commissioning sources.
  - Develop game-based approach to training tactical decision-making.

Total 16315

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602785A - Manpower, Personnel and Training  
Technology**

PROJECT  
**790**

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	12005	11869	11903	0
Appropriated Value	12071	11869	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-235	0	0	0
c. Omnibus or Other Above Threshold Reductions	-36	0	0	0
d. Below Threshold Reprogramming	0	0	0	0
e. Rescissions	-30	-110	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	4412	0
Current Budget Submit (FY 2002/2003 PB )	11770	11759	16315	0

Funding - Funds added in FY 2002 (\$4412) and FY 2003 (\$1436) to support design of training techniques for enhancing leadership competencies, development of new predictors of future soldier performance that can be used in a selection and classification system for the Objective Force, and the development of a game-based approach to training and tactical decision-making.



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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602786A - Warfighter Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	25698	27901	27061	0	0	0	0	0	0	0
283 AIRDROP ADV TECH	2767	3170	4591	0	0	0	0	0	0	0
C60 AC60	1993	897	1467	0	0	0	0	0	0	0
H98 CLOTHING & EQUIPM TECH	16125	17317	15955	0	0	0	0	0	0	0
H99 JOINT SERVICE COMBAT FEEDING TECHNOLOGY	4813	6517	5048	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) improves soldier survivability and performance by researching and investigating technologies for: combat clothing and personal equipment; combat rations and combat feeding equipment; and the air delivery of personnel and cargo. This program element supports the Army Transformation in the areas of improved dismounted soldier capabilities (project H98), logistics footprint reduction (project H99), and rapid deployment (project 283). The Clothing and Equipment Technology project (H98) funds cutting edge research and technologies for clothing, equipment, and high-pressure airbeam supported shelters. Technologies will enhance warfighter survivability from both combat threats (e.g., ballistics, flame, directed energy) and the field environment; enhance signature management and integration; provide alternative self-sufficient power; and significantly lighten the soldier's load. Human science is incorporated into modeling and analysis tools that will enable technologists and military users to trade-off potential warrior system capabilities and develop a human-centered warrior system design. The Joint Services Combat Feeding Technology program (H99) supports all Military Services, the Special Operations Command, and the Defense Logistics Agency with research and development of high impact/high payoff technologies for performance enhancing combat rations, packaging, and combat feeding equipment/systems. Research will enhance nutrient composition and consumption to maximize cognitive and physical performance on the battlefield; minimize physical, chemical and nutritional degradation of combat rations during storage; meet the needs of individual soldiers in highly mobile battlefield situations; and provide equipment and energy technologies to reduce the logistics footprint of field feeding while improving the quality of food service. Similarly, the Airdrop Advanced Technology project (283) supports all Services' requirements for air dropping larger combat and logistics loads while improving delivery accuracy, minimizing vulnerability of aircraft, and reducing life cycle costs. Investigation of technologies for safer, more combat efficient personnel parachutes addresses a critical capability for rapid deployment force projection, particularly into hostile environments. Contractors performing the work for this PE include: Alliant Technology, Inc., MN; General Dynamics, MI; South West Research Institute, TX; Ceradyne, Inc. CA; University of Virginia, VA; University of Rhode Island, RI; H.P. White Laboratory, MD; Irvin Aerospace, Inc., CA; and Vertigo, Inc., CA. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. It adheres to Tri-Service Reliance agreements on clothing, textiles, and operational rations and field food service equipment, with oversight and coordination provided by the Human Systems Reliance Panel, the

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

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**0602786A - Warfighter Technology**

Warrior Systems Technology Base Executive Steering Committee, and the Department of Defense (DoD) Food & Nutrition Research & Engineering Board. The program element contains no duplication with any effort within the Military Departments. Efforts are coordinated with those in PE 0603001A (Warfighter Advanced Technology). Work is performed by the Natick Soldier Center, Natick, MA.

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	25831	24659	26429	0
Appropriated Value	25971	28159	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-413	0	0	
c. Omnibus or Other Above Threshold Reductions	-63	0	0	
d. Below Threshold Reprogramming	280	0	0	
e. Rescissions	-77	-258	0	
Adjustments to Budget Years Since FY2001 PB	0	0	632	
Current Budget Submit (FY 2002/2003 PB )	25698	27901	27061	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for Combat Feeding (+1500), Affordable Guided Airdrop System (+1000), and Blisterguard Socks (+1000).

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- +1500 Combat Feeding - funds core technologies to produce rations that meet regulatory requirements for shelf stable products.
- +1000 Affordable Guided Airdrop System - evaluates Guidance, Navigation, and Control and improved pneumatic technologies for airdrop systems.
- +1000 Blisterguard Socks - evaluates textile technology for use in socks to reduce blisters and improve comfort.

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June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602786A - Warfighter Technology**

PROJECT  
**283**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
283 AIRDROP ADV TECH	2767	3170	4591	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project researches technologies to enhance personnel and cargo airdrop capabilities. These are key Army Transformation rapid deployment 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. This project will enhance the military's capability for global precision delivery and rapid force projection and supports the rapid deployment goal of the Army Transformation. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2159 -Investigated smart airbag technologies for roll-on/roll-off cargo airdrop and transitioned to 0603001A (Project 242).  
-Researched advancement of soft landing of personnel by a combined parachute and pneumatic muscle system.  
-Researched a concept for a pneumatic muscle soft landing system for heavy cargo using subscale testing and modeling and simulation.  
-Investigated advanced, low-cost parafoil designs for improved flight and landing flare performance.
- 608 -Applied state-of-the-art airdrop system models to reduce (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.

Total 2767

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602786A - Warfighter Technology**

PROJECT  
**283**

**FY 2001 Planned Program**

- 1213 - Identify and analyze candidate concepts for a low cost, precision airdrop resupply capability for humanitarian and other one-time-use operations.
    - Conduct market analysis for state-of-the-art technologies for decreasing rate of descent and automatic activation capabilities for personnel parachutes.
    - Conduct feasibility experiments with candidate low cost precision airdrop concepts and advanced cargo airdrop mechanisms.
    - Fabricate and conduct preliminary tests on miniaturized airdrop instrumentation package.
  - 900 - Incorporate additional advanced features into a second-generation three-dimensional high performance airdrop system model and validate with concurrent experimentation as part of a High Performance Computing (HPC) Grand Challenge program.
    - Simulate airdrop systems of interest to DoD, transition results, and package software into a user-friendly Graphical User Interface (GUI) environment for use as an "airdrop virtual proving ground".
  - 1000 - FY 2001 Congressional add to further research an Affordable Guided Airdrop System (AGAS) to include Guidance, Navigation and Control (GN&C) and improved pneumatic control systems.
    - Perform an integrated flight test utilizing AGAS technologies.
  - 57 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3170

**FY 2002 Planned Program**

- 1092 - Research additional components and technologies in support of the Precision Roll-on/Roll-off Air Delivery STO and transition to 6.3 STO programs.
  - 700 - Design automatic opening capability system prototypes and conduct systems integration/human factors analysis.
  - 799 - Utilize Airdrop System Modeling to simulate brassboards and prototypes in tech base and development programs (such as the Affordable Guided Airdrop System and the Advanced Tactical Parachute System) while validating the results with flight test data.
  - 2000 - Research concepts for, and feasibility of, developing a 20-ton, high altitude (25,000 ft), high offset (30 km) precision airdrop system to provide greater deployability and sustainability for the Objective Force.
- Total 4591

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

**June 2001**

BUDGET ACTIVITY

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PE NUMBER AND TITLE

**0602786A - Warfighter Technology**

PROJECT

**283**

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602786A - Warfighter Technology**

PROJECT  
**H98**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H98 CLOTHING & EQUIPM TECH	16125	17317	15955	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports the Army Transformation in the area of improved dismounted soldier capabilities by researching and investigating technologies to improve soldier survivability and performance. Areas of emphasis include: research to significantly lighten the soldier's load; lightweight materials for personal survivability (e.g., improved ballistic, flame, and directed energy protection, enhanced signature management); human science, modeling and analysis tools for optimizing soldier system clothing and equipment; three-dimensional textiles for achieving rapidly deployable wide-span airbeam supported shelters. These advanced technologies are being investigated to support the requirements of the Objective Force. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4220 - Validated ability of virtual prototyping tools to analyze form, fit, function, and assist in infantry warrior system design; identified promising techniques to disperse nano-particles in a variety of polymer structures likely to be applied in the warrior system as the first step towards significant weight reduction of the heaviest components.  
- Investigated five battlefield scenarios to appropriately model the combat effectiveness of warrior systems and components in the Integrated Unit Simulation System (IUSS).
- 4490 - Researched technology for transition to the PM-Soldier Systems that reduces the system weight of the individual countermine protective system (fielded in FY96) by 30-35%, while providing equal protection; defined requirements for assessment criteria and test methodology to determine ballistic casualty reduction potential of emerging technology; evaluated novel materials/systems demonstrating concepts to increase protection and reduce weight of personnel armor, for both head and torso, against emerging ballistic threats.
- 2251 - Established quantitative relationships between the volume of a carried load and performance on an obstacle course as well as the forces exerted by these loads on the body; completed and successfully demonstrated the utility of passive dynamic gait models; supported integration of automated measurement and data extraction system for human-system interface analysis and military clothing sizing and issue.  
- Synthesized new conductive polymers that have shown potential for application in the development of lightweight, flexible and wearable power generating devices for soldier systems.

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**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
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PROJECT  
**H98**

## FY 2000 Accomplishments (Continued)

- 2240 - Designed a dismounted soldier system signature evaluation and analysis plan to determine the total system baseline signature (i.e., visual, near-, mid-, and far-infrared, acoustic, electromagnetic); designed low cost breadboard to help mitigate experimental soldier system signature issues; analyzed experimental thermal signature reducing facepaint formulations to provide safe and effective means to manage the thermal signature of exposed skin.
  - Increased the level of achievable laser eye protection using polymer-based limiters to support all soldiers, both mounted and infantry, in the Objective Force.
  - Established test methodologies for flame resistant textile material systems for soldier protection.
  - Investigated advanced helmet technology design concepts and prioritized potential capabilities for integration into a future headborne integrated system for use by decision-makers to complete a complex tradoff analysis required in the next step of integrated headgear maturation/development.
- 2924 - Optimized wide span airbeam textile construction and demonstrated technologies through the fabrication and testing of representative prototypes. Completed the full-size shelter design (80 ft x 132 ft) and validated critical features with sub-scale models.
  - Advanced the reliability, affordability and safety of airbeam technology through the incorporation of new continuous manufacturing technologies and processes.

Total 16125

## FY 2001 Planned Program

- 5661 - Evaluate technology for virtual prototyping tools to develop warrior system designs, with a focus on integrated load carriage, helmet design, and component/capability placement on the torso and head; demonstrate the feasibility of incorporating nano-scale materials in soldier system components to reduce weight and/or enhance performance.
  - Determine required level of human system data points to enable quantitative measures of soldier system performance, validation of small unit combat analysis models, and development of soldier system virtual prototyping and design tools; begin focused effort to collect required human system data to accomplish those tasks.
- 5721 - Extend the IUSS individual/small unit combat model to provide the initial ability to assess the effects of restricted terrain (e.g., rooms, hallways, trenches) on warrior system performance.
  - Transition improved test methodology/assessment criteria for personnel armor systems to the acquisition community to enable the trade-off of protection, weight, mobility and affordability; mature novel concepts to increase protection and decrease the weight of personnel armor components.



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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602786A - Warfighter Technology**

PROJECT  
**H98**

**FY 2001 Planned Program (Continued)**

- 2305 - Determine effects of varied topographic and terrain conditions on soldier 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 virtual prototyping and design concepts.  
- Investigate and process electronic and photonic materials using electrospinning and electrostatic layer-by-layer deposition techniques into novel, high surface area nano-structures; assess energy density and conversion efficiency potential for future power generating devices for soldier use.
- 2293 - Show a 30-50% cost decrease compared to the cost of existing flame-resistant combat clothing systems while maintaining multiple threat protection levels.  
- Modify the breadboard design of millimeter-lens arrays for laser eye protection devices to decrease the length of the optical assembly to make them more compatible with human factors criteria. This technology will support all soldiers, including mounted and infantry, in the Objective Force.  
  
- 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.
- 1000 - FY 2001 Congressional add to investigate technology used in Blisterguard Socks to reduce blisters and improve comfort.
- 337 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 17317

**FY 2002 Planned Program**

- 7363 - Enhance the capabilities of virtual prototyping tools, focusing on the head and torso areas, to advance the state-of-the-art in designing body worn soldier clothing and equipment.  
- Produce breadboard prototype panels or system components made with nanomaterials for performance testing to determine the potential for significant system weight reduction and/or enhanced performance.  
- Continue focused effort to collect required human system performance data to support soldier system design decisions.
- 6100 - Develop close combat/small arms data and algorithms to assess warrior survivability and lethality at distances less than 25 meters.  
- Complete an improved personnel armor casualty assessment model that will permit evaluation of personnel armor systems against conventional and emerging ballistic threats.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602786A - Warfighter Technology**

PROJECT

**H98**

**FY 2002 Planned Program (Continued)**

- 2492 - Provide design guidance for load carrying equipment that enhances mobility performance across squad positions by 15%.  
- Improve energy density and conversion efficiencies of photovoltaic nanostructures to promising levels for soldier system use through unique materials, modeling, processing and fabrication strategies.

Total 15955

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

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<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602786A - Warfighter Technology</b>						<b>PROJECT</b> <b>H99</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H99 JOINT SERVICE COMBAT FEEDING TECHNOLOGY	4813	6517	5048	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Joint Services Combat Feeding Technology project researches and applies combat feeding and food system technologies to revolutionize the manner in which we sustain and support the Armed Forces, ensuring optimal nutritional intake. This project supports the Army Transformation in the areas of sustainability and reduced logistics footprint. Thrust areas include: applied research of combat rations, packaging, and combat feeding equipment/systems. Near-term goals include: enhancing nutrient composition and consumption to maximize cognitive and physical performance on the battlefield; reducing ration weight/volume and food packaging waste to minimize the logistics footprint; tailoring rations to the combat situation and radically improving mobility; reducing replenishment demand by extending shelf-life, permitting more extensive prepositioning of stocks, while maintaining initial quality; and providing equipment and energy technologies to reduce the logistics footprint of field feeding while improving the quality of food service. The work in this project supports all military Services, the Army's Objective Force, Special Operations Command, and the Defense Logistics Agency. The Army has Executive Agency responsibility for this DoD program. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2139 - Downselected competing reformer/fuel cell and cogeneration approaches. Matured and tested concept for Superheated Liquid Injected Cogeneration (SLIC) that provides electrical power and mix of high and low temperature heat ideal for field kitchens, reduces number of subsystems and moveable parts and increases efficiency and reliability. Transitioned SLIC to Advanced Technology Development.
- Researched and tested passive cold storage system for safe handling of perishable subsistence in a field environment.
- Designed, fabricated and tested breadboard 4 oz. Pocket Stoves to provide warrior light weight capability to rehydrate dehydrated rations, heat beverages, and provide personal hygiene.
- Completed long term experimental testing and maturation of a thermal fluid heat transfer and cogeneration system prototype to improve reliability and maintainability of field kitchens.
- Created concepts for a Self-Heated Group Ration (SHGR) to support the Objective Force. SHGR will provide group feeding without the logistics burden associated with field kitchens (90% reductions in manpower, weight, and cost).
- Completed front end analysis of food and packaging field waste management methods.

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

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PROJECT  
**H99**

**FY 2000 Accomplishments (Continued)**

- 1408 - Completed prototype development and matured technology for microwave sterilized rations through a commercial contract to improve nutritional/sensory quality.
  - Completed studies on enhancers/antioxidants, packaging models, and methodologies/carriers for smart food components for combat optimized ration components to enhance cognitive/physical performance.
  - Conducted in-house evaluations on items produced by novel dehydration technologies in combat ration products, demonstrating significant reduction in weight and cube of combat ration components.
  - Conducted research and testing of engineering processes for production of carrier matrices for bioengineered protein systems to enhance nutritional value for optimized future combat rations.
- 1266 - Researched the feasibility of accelerating the osmotic dehydration of fruits by sugar solutions and by employing both single and repeat cycles of high pressure to reduce processing cost of these ration components.
  - Researched the feasibility of incorporating nano-sized fillers into commercially available packaging materials optimizing barrier properties to extend ration shelf life.
  - Identified technologies for the conversion of native cellulose to foodstuffs for revolutionary survival ration; conducted a market survey to assess current conversion/digestion systems.
  - Investigated the production of volatile compound(s) that are unique to specific food-borne pathogens and the effects of food composition on chemical volatile distribution to provide the basis for handheld biosensors to quickly determine ration quality and safety in the field.

Total 4813

**FY 2001 Planned Program**

- 1590 - Integrate and test subsystem prototypes for Liquid-Injection Cogeneration, optimizing waste heat conversion and user safety, and transition to Advanced Technology Development for field kitchens.
  - Design packaging prototypes for SHGR including integration of food and heaters, and heat transfer modeling and testing to ensure environmental compliance and optimum performance at lowest cost.
  - Complete prototype development of Soldier Pocket Stove technology and transition to Advanced Technology Development to validate/demonstrate revolutionary non-powered combustion technology.
- 2136 - Mature technology and test combat optimized ration components to include engineered carrier matrices for bioengineered proteins, encapsulation technology for smart food ration components, and new delivery systems (i.e., gels) to increase cognitive/physical performance.

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602786A - Warfighter Technology**

PROJECT  
**H99**

**FY 2001 Planned Program (Continued)**

- Complete field test of products produced with advanced dehydration technologies which reduce ration weight, volume and total logistics costs; transition to fielded individual/group ration improvement programs.
- Fabricate prototype ration quality status indicators that can be monitored externally by military logistics personnel to ensure least fresh, first out and design totally integrated Class I supply/requisition/distribution concepts that support DoD/Department of Army logistic initiatives and minimize Class I logistical impacts and theatre stockpiles.
- Research and design ration packaging system prototypes that: will respond to the environment to provide a single packaging system for all rations with reduced signature; will prevent lipid oxidation, minimize undesirable odors, and help prolong quality retention of shelf stable ration items; and will use intercomponent films for multi-component ration items to increase product quality and menu variety.
- 1200 - Evaluate pressure effects on texture mediated by activation/release of native enzymes in fresh vegetables (pectin esterases) or meats (proteases) as a pretreatment to reduce dehydration or thermal processing requirements for ration components, while maintaining initial quality.
- Conduct processing trials to determine feasibility of utilizing and/or modifying existing methods and techniques; optimize processing parameters to enhance orientation of nanocomposite fillers, such that gas diffusion will be minimized, extending barrier protection for combat rations.
- Explore the feasibility of non-enzymatic hydrolysis techniques, such as acid or alkaline hydrolysis, alone or as a pretreatment to enzyme hydrolysis for potential conversion of biomass to foodstuff that would support soldiers in survival situations.
- Conduct tests with mixed culture samples to evaluate the potential and time for detecting and differentiating specific volatile compounds from food pathogens for use in easy-to-use, lightweight, field biosensor.
- 1493 - Explore innovations in food preservation technologies (thermal and non-thermal); evaluate the feasibility of novel nutrient delivery systems; research foundations for enhancing human performance in stressful situations through nutritional initiatives; exploit material sciences for advanced food packaging systems and pursue food safety detection and intervention methodologies for countering both bioterrorism threats and natural microbial pathogens in military feeding operations.
- 98 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 6517

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BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602786A - Warfighter Technology**

PROJECT  
**H99**

**FY 2002 Planned Program**

- 1960 - Evaluate technologies and functional compounds to prevent/minimize ration component degradation and freezing in extreme temperatures.
  - Conduct validation testing of selected carriers for "smart" food ration components. Transition to Advanced Technology Development.
  - Identify pathogen specific Volatile Organic Compounds (VOCs) and initiate exploratory development of recognition elements for incorporation into a surface scanning biosensor for ration contamination assessment.
  - Evaluate sensors and other components of the computer-based externally monitored ration quality system.
  - Optimize formulations, identify suitable packaging and perform in-house comparison studies of microwave sterilized and radio frequency sterilized ration components.
  - Investigate ration packaging technologies, including nanocomposites, ultra-high barrier polymers, barrier films and films with chromatic pigments, to extend quality/shelf-life of combat rations and reduce their weight and signature.
- 1267 - Complete evaluations of pressure accelerated ration processing and transition to Advanced Technology Development.
  - Complete investigation of mixed culture samples and develop strategy for implementation of bacterial volatile compounds with field biosensors for ration contamination assessment.
  - Design and assess methodologies for indexing the satiety value of military rations.
  - Investigate feasibility of transdermal nutrient delivery systems and identify candidate nutrients based on bioactivity and physical/chemical properties.
- 1821 - Complete technical demonstration of Solid-state Thermo Electric Power (STEP) cogenerator prototype. Transition to Development: Mobile Kitchen Trailer (MKT) Improvement Program.
  - Complete work on heater, activator, and heat transfer mechanisms for SHGR. Transition to Advanced Technology Development.
  - Design and fabricate thermoacoustic refrigerator prototype and test concepts for safely tempering frozen meats in a field environment.
  - Design and fabricate experimental filtration and distillation for water conservation and re-utilization program for field kitchens. Test and evaluate non-stick coatings and sanitizing solutions for future waterless sanitation system for field kitchens.

Total 5048

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BUDGET ACTIVITY

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PE NUMBER AND TITLE

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PROJECT

**H99**

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**BUDGET ACTIVITY**  
**2 - APPLIED RESEARCH**

**PE NUMBER AND TITLE**  
**0602787A - Medical Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	169967	111696	82494	0	0	0	0	0	0	0
838 NEUROTOXIN EXPOSURE TRTMT	9547	0	0	0	0	0	0	0	0	0
841 COMPUTER-ASST MINIMALLY INVASIVE SURGERY	9547	13872	5000	0	0	0	0	0	0	0
845 BONE DISEASE RESEARCH PROGRAM	6231	5945	0	0	0	0	0	0	0	0
863 BTLFLD SURGICAL REPLAC	2386	0	0	0	0	0	0	0	0	0
869 T-MED/ADVANCED TECHNOLOGY	5073	4426	4500	0	0	0	0	0	0	0
870 DOD MED DEF AG INF DIS	23250	24612	25684	0	0	0	0	0	0	0
872 NEUROFIBROMATOSIS RSCH	14320	0	0	0	0	0	0	0	0	0
873 HIV EXPLORATORY RSCH	12212	11473	11069	0	0	0	0	0	0	0
874 CBT CASUALTY CARE TECH	8384	10212	9086	0	0	0	0	0	0	0
878 HLTH HAZ MIL MATERIEL	9072	10545	11408	0	0	0	0	0	0	0
879 MED FACT ENH SOLD EFF	7892	8361	8747	0	0	0	0	0	0	0
921 OVARIAN CANCER RESEARCH	11456	0	0	0	0	0	0	0	0	0
952 MUSCULOSKELETAL INJURIES	5729	0	0	0	0	0	0	0	0	0
953 DISASTER RELIEF & EMERGENCY MEDICAL SVC (DREAMS)	9547	0	0	0	0	0	0	0	0	0
962 POLYNITROXYLATED HEMOGLOBIN	1909	0	0	0	0	0	0	0	0	0
963 NATIONAL MEDICAL TESTBED	14320	0	0	0	0	0	0	0	0	0
964 INFORMATICS-BASED MED. EMERG DECIS TOOLS (IMED)	4295	5945	0	0	0	0	0	0	0	0
965 EYE RESEARCH	1909	0	0	0	0	0	0	0	0	0
966 BLOOD RESEARCH	5251	0	0	0	0	0	0	0	0	0
967 DYE TARGETED LASER FUSION	2864	3963	0	0	0	0	0	0	0	0
968 SYNCH BASED HI ENERGY RADIATION BEAM CANCER DETECT	4773	0	0	0	0	0	0	0	0	0
96A EMERGENCY HYPOTHERMIA	0	2972	0	0	0	0	0	0	0	0
96B REAL TIME HEART RATE VARIABILITY TECHNOLOGY	0	2477	0	0	0	0	0	0	0	0



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June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>				PE NUMBER AND TITLE <b>0602787A - Medical Technology</b>							
977	EMERGING INFECTIOUS DISEASES	0	6893	7000	0	0	0	0	0	0	

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This program element supports focused research for healthy, medically protected soldiers, and funds research consistent with the "Medical", "Survivability", and "Future Warrior" technology areas of the Objective Force. The primary goal of medical research and development is to sustain medical technology superiority to improve the protection and survivability of U.S. forces on conventional battlefields as well as in potential areas of low intensity conflict and military operations short of war. This program element funds applied research in Department of Defense (DOD) medical protection against naturally occurring diseases of military importance and combat dentistry, as well as applied research for Department of Army care of combat casualties, health hazard assessment of military materiel, and medical factors enhancing soldier effectiveness. This program element is the core DOD technology base to develop methods and materials for infectious disease prevention and treatment including vaccines, prophylactic and therapeutic drugs, insect repellents, and methods of diagnosis and identification of naturally occurring infectious diseases; prevention and treatment of combat maxillofacial (face and neck) injuries, and essential dental treatment on the battlefield; combat casualty care of trauma and burns due to weapons, organ system survival, shock resulting from blood loss and infection, blood preservation, and potential blood substitutes for battlefield care; assessment of the health hazards of military materiel, and the sustainment or enhancement of soldier performance. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program is managed by the U.S. Army Medical Research and Materiel Command. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	174199	75729	70269	0
Appropriated Value	176636	112729	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-4247	0	0	
c. Omnibus or Other Above Threshold Reductions	-652	0	0	
d. Below Threshold Reprogramming	15	0	0	
e. Rescissions	-1785	-1033	0	
Adjustments to Budget Years Since FY2001 PB	0	0	12225	
Current Budget Submit (FY 2002/2003 PB )	169967	111696	82494	0

Change Summary Explanation: Funding - FY 2001 includes the following Congressional adds. The objective of these one year adds is to develop and complete the following:  
 Project 841, Computer-Assisted Minimally Invasive Surgery (+12000)- By Congressional direction this program funds the development of computer-based surgical devices.  
 Project 841, Minimally Invasive Research for Brain and Spine (+2000)- By Congressional direction, this is to fund continuing research into the development of minimally invasive surgical procedures for the brain, spinal cord and spine.  
 Project 967, Dye Targeted Laser Fusion (+4000)- These funds are for research into hemorrhage control by sealing tissues using medical lasers.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602787A - Medical Technology**

Project 96A, Emergency Hypothermia (+3000)- By Congressional direction, this program funds research into emergency hypothermia treatments.

Project 964, IMED Tools (+6000)- By Congressional direction, these funds are only for the IMED Tools Project, which addresses the limitations of medical care in the face of a mobile, digitized, high-threat military environment.

Project 845, Osteoporosis and Bone Disease Research Program (+6000)- Study bone physiology leading strategies to improve bone health of young men and women, reducing the incidence of stress fracture during physically intensive training.

Project 96B, Real-Time Heart Rate Variability Technology (+2500)- By Congressional direction, this is to conduct research of real-time heart rate variability technology to enhance trauma victim survivability.

FY 2002 funding increased to support the following:

Project 841- Computer-Assisted Minimally Invasive Surgery (+5000)

Project 977- Emerging Infectious Diseases (+7000)

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

**June 2001**

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602787A - Medical Technology</b>						<b>PROJECT</b> <b>841</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
841    COMPUTER-ASST MINIMALLY INVASIVE SURGERY	9547	13872	5000	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** By Congressional direction, this program supports continuation of development of sophisticated computer-based surgical devices. This program will improve technologies developed under the program, including, but not limited to, integration of an intraoperative ultrasound imaging device, a small fiber endoscope, and application of an intraoperative magnetic resonance imaging device.

**FY 2000 Accomplishments**

- 9547    Continued development of minimally invasive surgical technologies in five key Clinical Focus Areas: Cardiovascular disease, Cancer, Stroke, Trauma and Critical Care, and New Initiatives at Massachusetts General Hospital's Center for Innovative Minimally Invasive Therapy (CIMIT).

Total 9547

**FY 2001 Planned Program**

- 13460    - Continue development of minimally invasive surgical technologies at the Center for Innovative Minimally Invasive Therapy.
- Continue Minimally Invasive Surgery research at Georgetown University's Department of Radiology.
- 412      Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 13872

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**841**

## FY 2002 Planned Program

- 5000 Continue development of minimally invasive surgical technologies at the Center for Innovative Minimally Invasive Therapy.
- Total 5000

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

June 2001

<b>BUDGET ACTIVITY</b> <b>2 - APPLIED RESEARCH</b>			<b>PE NUMBER AND TITLE</b> <b>0602787A - Medical Technology</b>						<b>PROJECT</b> <b>869</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
869 T-MED/ADVANCED TECHNOLOGY	5073	4426	4500	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports focused research for the soldier contributing to casualty avoidance, casualty detection, and evacuation and treatment of casualties through application of physiological status monitoring technologies (biophysical and biochemical sensors and fusion) as outlined in the Medical and Future Warrior Objective Force Technology Areas. Research efforts focus on developing a wearable, integrated system to determine soldier physiological status. This includes developing the ability to quickly and accurately determine when a soldier is minimally impaired but still capable of functioning. Work will also focus on identification and initial development of parallel and supporting technologies and systems, including medical informatics, medical artificial intelligence, and data mining tools. Intramural research under this project is conducted at the following U.S. Army Medical Research and Materiel Command laboratories: the Aeromedical Research Laboratory, the Research Institute of Environmental Medicine, the Institute of Surgical Research, and the Walter Reed Army Institute of Research and its overseas laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2094 - Conducted applied research on a microimpulse radar unit for noninvasive cardiac output monitoring, and an acoustic method to detect tension pneumothoraces (collapsed lung) to measure the physiologic state of soldiers noninvasively and help battlefield medics diagnose and treat wounded soldiers. The cardiac output monitor demonstrated decreased cardiac output due to blood loss (as expected). Pneumothorax detection requires further study to improve reliability.
  - Began investigation into a noninvasive intracranial pressure monitor to assess intracranial pressure in closed head trauma and started the design of a high frequency focused ultrasound device that will stop bleeding in organs.
- 2491 - Conducted applied research to construct a prototype for first-generation Warfighter Physiological Status Monitoring (WPSM) of soldier status and conducted evaluations on soldiers undergoing exercises at the Dismounted Battlespace Battle Lab.
  - Tested the ability of the Land Warrior's Dead Reckoning Module to detect projectile impacts on a soldier's body and to collect mission-specific physiological data from soldiers with the goal of helping the medic assess the soldier's health status.
- 488 - Conducted applied research on the Joint Medical Operations-Telemedicine Advanced Concept Technology Demonstration (ACTD) by developing and evaluating Theater Telemedicine Team operational concepts to improve healthcare delivery in the battle zone.

Total 5073

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**869**

**FY 2001 Planned Program**

- 1896 - Conduct applied research to measure the physiologic state of soldiers by evaluating prototype microwave and acoustic devices for the detection of pneumothorax (collapsed lung), hemothorax (bleeding in chest), and subdural hematoma (head trauma) in large-animal models of these conditions. Evaluate wide band and narrow band radar approaches to heart rate and respiratory rate monitoring through clothing and mission-oriented protective posture (MOPP) gear.
    - Assess systems to identify a wounding event based on characteristic acoustic signatures produced by projectiles impacting the body. Investigate methods to establish a database of human physiological responses collected immediately after severe trauma that will be the basis of algorithms to help combat medics diagnose wounded soldiers.
  - 2399 - Conduct applied research to continue support for the WPSM to assess and predict individual warfighter status. Utilize the WPSM database and data acquisition and management capabilities, to support the formulation and testing of modeling strategies.
    - Generate knowledge management system to reduce information from WPSM and predictive performance and health risk models to only that which is essential to commanders. This provides the basis of a sensor fusion and situational interpretation of soldier physiological data.
  - 131 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 4426

**FY 2002 Planned Program**

- 1978 - Conduct applied research to measure the physiologic state of soldiers by testing and refining a prototype microwave or acoustic device to detect pneumothorax, hemothorax, and subdural hematoma through clothing and MOPP gear. Construct a prototype device based on the principles of pulse plethysmography (measuring variations in the size of an organ or body part on the basis of the amount of blood passing through or present in the part) and pulse wave transmission for the measurement of systolic, diastolic, and mean blood pressures.
    - Develop and test a prototype system to detect a wounding event by identifying characteristic acoustic signatures of projectiles impacting the body. Establish a database of human physiological responses collected immediately after severe trauma.
  - 2522 - Conduct applied research to continue support for WPSM to assess warfighter health status. Develop knowledge management system to reduce information from WPSM and predictive and health risk models to only that which is essential to warfighters.
    - Utilize WPSM database, and data acquisition and management capability, to support the development and testing of model strategies to predict individual warfighter status, as a component of technologies applied to the "Future Warrior" technology area. This effort will improve near real-time assessment of physiological performance, optimizing utilization of the individual warfighter.
- Total 4500

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602787A - Medical Technology**

PROJECT

**869**



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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>			PE NUMBER AND TITLE <b>0602787A - Medical Technology</b>						PROJECT <b>870</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
870 DOD MED DEF AG INF DIS	23250	24612	25684	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports development of medical countermeasures to naturally occurring infectious diseases consistent with the "Medical" technology area of the Objective Force. Infectious diseases pose a significant threat to forces deployed outside the United States. Countermeasures will protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations. Intramural research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Medical Research Institute of Infectious Diseases, the Walter Reed Army Institute of Research and its overseas laboratories, and the Naval Medical Research Center and its overseas laboratories. Major contractors are the Israeli Defense Force Medical Corps, Israel; ProMed Trading, SA, Panama; Nanogen Inc., San Diego, CA; and the Research Triangle Institute, Research Triangle Park, NC. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 7921 Refined screening methods for evaluating anti-malaria drugs, new methods for measuring immune responses in malaria infection, and new assays for characterizing malaria parasites during development of field trial sites.
  - Conducted multiple animal tests of candidate malaria vaccines, targeting all stages of parasite's life cycle. Explored efficacy of various dosing schedules for administering multiple candidate vaccines to test animals.
  - Continued screening of candidate anti-malaria drugs, and evaluation against malaria parasites collected in Thailand, Kenya, Brazil, Peru, Indonesia, and Egypt.
- 4244 Modified candidate vaccines against major causes of bacterial diarrhea (three organisms), evaluated them against specimens from Thailand, China, and Vietnam. Prepared vaccine pilot lots in accordance with FDA requirements, for later animal and human testing.
- 5698 Continued co-development (with biological defense program) of rapid infectious organism test battery for field use. Advanced understanding of hepatitis E infection process as step toward vaccine development. Animal tested candidate scrub typhus vaccine. Completed second stage of Phase I human test of meningitis B vaccine. Further evaluated candidate compounds to replace current military insect repellent.
- 5387 Elaborated immune mechanisms critical to development of effective dengue vaccine. Developed new screening methods to improve dengue vaccine safety testing. Explored immune factors in severe dengue fever and dengue hemorrhagic fever.

Total 23250

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**870**

**FY 2001 Planned Program**

- 11557 - Determine human immune response factors that protect against malaria, modify candidate vaccines to enhance immunogenicity, and conduct monkey-safety and immunogenicity trials on selected vaccines for both falciparum and vivax malaria species.  
 - Determine the three-dimensional structure of vital malaria enzymes to identify drugs that can disrupt the enzyme's function. Determine through genetic manipulation the function of specific malaria proteins to identify the best drug targets.  
 - Evaluate newer, more potent candidate drugs for prophylaxis and treatment of multi-drug resistant strains of malaria and test in monkeys.
  
  - 7072 - Study epidemiology of Campylobacter to determine the most prevalent Campylobacter serotypes to guide vaccine development and conduct clinical study to determine if Campylobacter antigens are involved in the occurrence of Guillain-Barre Syndrome (GBS) in order to ensure a safe vaccine design.  
 - Design and test in animal models vaccine candidates for Shigella and ETEC, including a vaccine expressing proteins from both, and a Campylobacter vaccine given with and without an immune booster.
  
  - 4124 -Conduct research on the components of diagnostic tests to be applied to a common diagnostic device for biological defense and infectious disease threats, on vaccines to prevent meningitis caused by Group B meningococcus, and on control of insect vectors of disease.  
 - Characterize a genetically modified candidate Group B meningitis vaccine to verify that it exhibits reduced toxicity and high immunogenicity, and evaluate the effect of immune boosters on efficacy.  
 - Conduct testing of an insect repellent to replace the current military repellent, DEET, to ensure that it meets Environmental Protection Agency safety requirements and that it repels chiggers.
  
  - 1377 - Conduct research on vaccines to prevent viral diseases capable of interrupting combat operations by constructing improved, second generation live-attenuated vaccines for dengue. Evaluate the protective efficacy of an orally administered DNA vaccine against dengue 2 in mice. Improve DNA vaccines delivered by gene-gun and test in animals.
  
  - 482 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 24612

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**870**

**FY 2002 Planned Program**

- 11299 - Complete preclinical testing of vivax malaria vaccine candidates and conduct animal studies to evaluate safety and immunogenicity of a candidate falciparum malaria vaccine.  
 - Validate a DNA-based test for measuring malaria parasites in blood and screen candidate antimalarial drugs to determine the safety profile, dose levels, and toxicity in animal models to meet FDA requirements for human studies.
- 5384 - Complete preclinical testing of Shigella dysenteriae vaccine candidate as required by the FDA and conduct animal-safety and immunogenicity studies of ETEC and Campylobacter candidate vaccines.
- 3061 - Modify the candidate scrub typhus vaccine to make it more broadly protective. Design improved vaccine candidates to prevent acute respiratory disease caused by adenovirus in military trainees.  
 - Evaluate candidate insect repellent compounds to replace DEET and design final components of a system to provide identification and control of the mosquitoes that transmit dengue fever.  
 - Validate DNA-based tests for the identification of militarily important pathogens from Southeast Asia and incorporate these tests onto the Department of Defense's Common Diagnostic System Platform. Complete diagnostic test validation of the nucleic acid-based tests for identification of Shigella flexneri, malaria, dengue, and hantavirus.
- 5940 - Complete preclinical testing of a candidate hantavirus DNA vaccine in compliance with FDA standards. Screen antiviral compounds for activity against hantaviruses to support improving drug therapy.

Total 25684

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

June 2001

BUDGET ACTIVITY <b>2 - APPLIED RESEARCH</b>			PE NUMBER AND TITLE <b>0602787A - Medical Technology</b>						PROJECT <b>873</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
873 HIV EXPLORATORY RSCH	12212	11473	11069	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports the "Medical" technology area of the Objective Force by conducting applied research of improved diagnostics, epidemiology, candidate immunogens, promising drugs and behavioral modification for prevention and treatment of human immunodeficiency virus (HIV). Main efforts include developing experimental models of disease, preparation of new vaccine candidates, improved diagnosis of disease, and risk assessment. Intramural research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Walter Reed Army Institute of Research and its overseas laboratories, and the Naval Medical Research Center and its overseas laboratories. Major contractors are the Henry M. Jackson Foundation, Rockville MD; McKesson Bioservices, Rockville MD; SRA Technologies, Falls Church VA; Harvard University, Cambridge MA; and Kenya Medical Research Institute, Kenya. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 12212 - Continued efforts to characterize various strains of HIV virus from samples collected worldwide. Further characterized components of HIV virus that may induce protective response leading to vaccine development.
- Conducted pre-clinical studies of vaccine candidates based on variety of technologies and elucidated cellular mechanisms of immune cells when confronted with HIV virus.
- Continued field surveys of high-incidence disease areas (Uganda, Kenya, Thailand) in preparation for human clinical trials.

Total 12212

**FY 2001 Planned Program**

- 11142 - Conduct specialized laboratory studies of HIV virus and human host cell interactions, including virus entry into human cells, targeting of HIV vaccines to human immune cells, binding of candidate vaccines to human immune cells, and conduct studies of HIV virus and immune system factors that are associated with immunity.
- Develop manufacturing processes and produce pilot lots of vaccine (VEE replicon particles, a recombinant anthrax-vectored vaccine and a mucosally administered vaccine). Also conduct sample processing and storage activities in support of vaccine testing and development.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**873**

## FY 2001 Planned Program (Continued)

- Conduct multi-service, multi-center clinical studies of the effectiveness of testing for HIV drug resistance for the management of HIV infection in military service members and other military health-care beneficiaries.
- Conduct studies of candidate vaccines (an orally administered *S. flexneri*-vectored vaccine and a subtype E naked-DNA vaccine) in animal models to determine safety and efficacy for producing an immune response before studies are begun in humans.

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

Total 11473

## FY 2002 Planned Program

- 11069 - Conduct specialized laboratory studies of HIV virus and human host cell interactions, including virus entry into human cells, targeting of HIV vaccines to human immune cells, binding of candidate vaccines to human immune cells; and conduct studies of HIV virus and immune system factors that are associated with immunity.
- Conduct studies of candidate vaccines in animal models to determine safety and efficacy for producing an immune response before studies are begun in humans.
- Develop manufacturing processes and produce pilot lots of vaccine (DNA vaccines for subtypes D&E and Modified Vaccinia Ankara (MVA) vaccine for subtype D).

Total 11069

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**874**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
874      CBT CASUALTY CARE TECH	8384	10212	9086	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project addresses investigation of the treatments for weapons-induced trauma and shock due to blood loss on the battlefield in order to provide healthy, medically protected soldiers as outlined in the "Medical" technology area of the Objective Force. This project funds the core technology base to develop concepts, techniques, and material for the treatment and return-to-duty of soldiers wounded in combat and to support low-intensity combat as well as military operations other than war. It also funds technologies for resuscitation fluid and methods to prolong the shelf life of blood products. Intramural research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Institute of Surgical Research, and the Walter Reed Army Institute of Research and its overseas laboratories. A major contractor is the University of Washington, Seattle, WA. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1621 - Conducted applied research to reduce the logistical burden of blood products on the battlefield by studies to develop a liquid red blood cell storage system that increase the current six-week storage time to ten weeks. Began evaluation of techniques for the formulation and assessment of dried plasma products.
- 1518 - Conducted applied research in novel methods of stopping bleeding and limiting blood loss by evaluating the potential use of Food and Drug Administration (FDA)-approved drugs to decrease blood loss after severe liver injury. Assessed the importance of hypothermia as a means of stopping blood loss (coagulopathy) during hemorrhage.
- 2667 - Conducted applied research into low blood pressure resuscitation; determined the arterial pressure at which rebleeding occurs during resuscitation to enhance the resuscitation capabilities for combat medics.
  - Evaluated concentrated resuscitation fluid therapy to reduce battlefield deaths after combined brain trauma and hemorrhage. Identified the effects of hemorrhage on gene expression to find novel ways of preventing shock.
  - Developed nitric oxide inhibitors to prevent injury caused by low blood flow after hemorrhage.

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602787A - Medical Technology**

PROJECT

**874**

## FY 2000 Accomplishments (Continued)

- 878 Conducted applied research on novel methods to minimize, repair, and prevent injuries to soft tissues by examining the neuroprotective efficacy of biologic compounds such as an oxygen-carrying red blood cell substitute and enzyme inhibitors that protect against injury caused by loss of blood, a major cause of death on the battlefield. Studied therapies to reduce the effects of burns and smoke inhalation suffered by soldiers on the battlefield.
  
- 1700
  - Evaluated medical command and control and patient management software capabilities on lightweight telemedicine hardware that enable deployed Joint Forces to supply better patient care as part of the Medical Operations-Telemedicine Advanced Concept Technology Demonstration.
  - Developed and evaluated Theater Telemedicine Team to provide operational support concepts for deployed forces.

Total 8384

## FY 2001 Planned Program

- 1202 - Conduct applied research on a freeze-drying process for plasma and evaluate the dangerous inflammatory effects from blood stored for varying periods of time to reduce the logistical burden of blood products on the battlefield.
- 2311
  - Conduct applied research in novel methods of stopping bleeding and limiting blood loss by continuing the assessment of FDA-approved drugs for decreasing blood loss following severe injury to prevent battlefield hemorrhage related deaths.
  - Test efficacy of recombinant clotting factor VIIa to stop bleeding from various types of injuries. Construct a prototype high frequency-focused ultrasound device to stop bleeding in organs.
- 2886
  - Conduct applied research in new methods of resuscitation by comparing various resuscitation fluids in animal models to control hemorrhage while kept at low blood pressure; compare controlled versus uncontrolled hemorrhage to determine the best animal model to predict the response of humans and examine inflammation in animal models to reduce hemorrhagic shock during resuscitation.
  - Develop a second generation eye oximeter to noninvasively measure if the brain is getting enough oxygen.
  - Evaluate lower body negative pressure as a surrogate model of hemorrhagic shock to allow the gathering of data on humans without having to remove their blood.
- 2105
  - Conduct applied research on novel methods to minimize, repair, and prevent injuries to hard and soft tissues to evaluate repair methods using a large-animal model for contaminated bone defects of the extremities.
  - Test the effect of aerosolized indomethacin to reduce the effects of smoke inhalation. Design a delivery system for the nasal application of ketamine to manage trauma-related pain.
  - Evaluate physiologic tolerance levels following traumatic brain injury and a treatment approach to injury-induced edema.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**874**

## FY 2001 Planned Program (Continued)

- 1500 - This one-year Congressional add will conduct research in methods to purify blood products right on the battlefield. It will fund Emergency Blood Purification for Combat Casualty Care.
  - 208 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 10212

## FY 2002 Planned Program

- 1020 - Conduct applied research to reduce the logistical burden of blood products on the battlefield by refining the freeze-drying process for plasma to result in efficient and consistent production of a stable freeze-dried product for field application. Complete design and testing of a prototype device to detect infectious diseases such as human immunodeficiency virus (HIV) in blood to make transfusions safer.
- 2789 - Conduct applied research in novel methods of stopping bleeding and limiting blood loss by selecting the most effective FDA-approved drugs for decreasing blood loss following severe liver injury. Complete the examination of the safety and efficacy of recombinant factor VIIa in the treatment of traumatic brain injury and in generalized uncontrolled hemorrhage.
  - Refine the prototype high frequency focused ultrasound device that will stop bleeding in organs.
  - Complete the evaluation of the lower body negative pressure as a surrogate model of hemorrhagic shock.
- 2601 - Conduct applied research in new methods of resuscitation by completing the study of various resuscitation fluids and recommending the best commercial off-the-shelf (COTS) fluid.
  - Examine methods to modify inflammatory processes in animals subjected to severe blood loss to reduce shock and improve survival.
  - Complete the construction of a second-generation eye oximeter to noninvasively measure that the brain is getting enough oxygen.
- 2676 - Conduct applied research on novel methods to minimize, repair, and prevent injuries to hard and soft tissues and complete the evaluation of repair methods on a large-animal model for contaminated bone defects of the extremities.
  - Construct and test a device to measure absolute cerebrospinal fluid pressure after head trauma and thereby reduce deaths due to increased cranial pressure.
  - Conduct animal trials of a molecular biology-based method to reduce mucus secretion in bronchioles after smoke inhalation and thereby lower the death rate.

Total 9086



**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602787A - Medical Technology**

PROJECT

**874**

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**878**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
878 HLTH HAZ MIL MATERIEL	9072	10545	11408	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This supports "Medical" and "Survivability" Objective Force Technology Areas with focused research for the soldier on protection from health hazards associated with materiel and operational environments. Emphasis is on identification of health hazards inherent to the engineering design and operational use of equipment, systems and material used in Army combat operations and training. Specific hazards include repeated impact/jolt in combat vehicles and aircraft; blast overpressure and impulse noise generated by weapons systems; toxic chemical hazards associated with deployment into environments contaminated with industrial and agricultural chemicals; non-ionizing radiation directed energy sources (laser); and environmental stressors (e.g. heat, cold, terrestrial altitude). Specific research tasks include characterizing the extent of exposure to potential hazards; delineating exposure thresholds for illness or injury; identifying exposure thresholds for performance degradation; establishing biomedical databases to support protection criteria; and developing and validating models for hazard assessment, injury prediction, and health and performance protection. Intramural research is conducted at the Aeromedical Research Laboratory, the Research Institute of Environmental Medicine, and the Walter Reed Army Institute of Research. Major contracts are with Universal Energy Systems and JAYCOR. Additionally, numerous Cooperative Research and Development Agreements (CRDAs) are held with universities and independent laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1126 Characterized damage mechanisms to predict injury thresholds for emerging blue light laser systems (wavelengths equal to 400-500nm) that are being considered in future combat systems.
- 550 Determined range safety standards to prevent dazzling of pilots and vehicle operators from short duration laser flash effects.
- 649 Produced an interim Health Hazard Assessment method and standard for repeated jolt that will be important to guide design of the future combat system so that it does not impair health or performance of the soldier.
- 650 Determined the effect of cockpit airbag system deployment on in-flight injury rates and ability to land an aircraft.
- 933 Created and refined a user-friendly method for the operator to test visual display quality of psychophysical information to determine the display's serviceability in order to insure optimal display quality.
- 1461 Described pathophysiology (damage to body) of combined fire gas inhalation exposure for predictive modeling of combined gas injury and incapacitation, which will lead to the development of effective countermeasures to toxic fumes.

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**878**

**FY 2000 Accomplishments (Continued)**

- 1269 Established a research program to develop operational guidelines and design criteria for mass properties of head-supported devices based on warfighter injury risk and performance degradation, which will reduce acute and chronic musculoskeletal injuries
- 592 Reported on the performance of alternative helmet fitting systems to prevent head injury, which will provide critical analysis to materiel developers in helmet fabrication.
- 1209 Verified that proposed animal models were strong predictors of human blunt trauma injury and will produce biomedically valid design criteria for body armor developers.
- 633 Evaluated five technologies for use in rapid water microbiological contamination test kits including competing efforts in genetic recognition and identification of microbes. The selected kit will provide for rapid analysis of environmental hazards to deploying soldiers.

Total 9072

**FY 2001 Planned Program**

- 1500 Characterize the effect of head and eye movement on heat dispersion through the retina to improve thermal retinal injury models and improve standards for protection.
- 1026 Determine risk of eye injury to Army aircrew in helicopters equipped with cockpit airbag systems which will lead to guidelines designed to maximize aviator safety during in-flight mishaps.
- 1106 Conduct field studies for repeated jolt during ground troop training exercises, which will be used to develop countermeasures to reduce injury rates of soldiers in tactical vehicles.
- 500 Research methods to reduce the effect of the overlapping of visual fields in binocular helmet mounted displays that could increase performance rates.
- 1850 Extend the combined gas injury incapacitation predictive models to include irritant gases, which will reduce the potential for toxic inhalation injury.
- 1801 Refine mass property guidelines of head-supported devices, which will be used to create strategies to reduce injury rates among aviators due to the aviator helmet design.
- 642 Determine the role of rotational head injury in helmet design to develop effective strategies to reduce injury rates.
- 1877 Validate predictive finite element models of blunt trauma, incorporating impact measurement, response model, and injury correlates to the develop criteria for assessing the impact of blunt trauma injury.
- 243 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 10545

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**878**

**FY 2002 Planned Program**

- 1440 Identify, through micro-gene array techniques, promising candidate pharmaceuticals to arrest apoptotic mechanisms that destroy healthy photoreceptors near the primary retinal injury site to enhance protective strategies for soldiers.
  - 1490 Establish and test standard methodologies for evaluating restraint technologies for tactical vehicles and aircraft.
  - 1495 Establish visual performance criteria for the integration of flat panel displays into helmet mounted displays. The results of this research will be to develop enhanced imaging and display technologies to optimize soldier performance in degraded battlefield environments (e.g. fog, smoke etc).
  - 1390 Extend the combined gas injury incapacitation predictive models to include particles in aerosols to develop protective measures in smoke filled buildings and in tactical vehicles penetrated by enemy rounds.
  - 1290 Validate standards for head-supported mass for aviator injury risk. This research will enhance soldier performance while causing a reduction in acute and chronic injuries due to the increased equipment requirements placed on the warfighter.
  - 1285 Propose new standards for minimum impact performance for ground/airborne troop helmets to minimize injury and stress during military operations. This research will develop advanced protective technologies for aircrew and airborne elements of the Objective Force.
  - 1538 Develop bioreporters of reproductive effects using genomic and proteomic technologies with *C. elegans*, to provide faster and comprehensive toxicological hazards assessment.
  - 1480 Field neurobehavioral toxicity assay in support of ongoing monitoring programs for water-borne contaminants.
- Total 11408

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**879**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
879 MED FACT ENH SOLD EFF	7892	8361	8747	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This supports "Medical" and "Survivability" technology areas of the Objective Force with research for the soldier focused on preventing health and performance degradation in the military environment. Emphasis is on identification of baseline physiological performance and assessment of degradations produced by operational stressors. This database and collection of rules and algorithms for performance degradation in multistressor environments form the basis for the development of behavioral, training, pharmacological, and nutritional ("skin-in") interventions to prevent decrements and sustain soldier performance. Key stressors include psychological stress from isolation, new operational roles, and frequent deployments; inadequate restorative sleep; prolonged physical effort and inadequate hydration in extreme environments; desynchronization of biological rhythms during deployments across multiple time zones and night operations; and thermal and altitude stress. Research under this project is conducted at the Aeromedical Research Laboratory, the Research Institute of Environmental Medicine, and the Walter Reed Army Institute of Research and its overseas laboratories. Major contract is with JAYCOR. Additionally, numerous Cooperative Research and Development Agreements (CRDAs) are held with universities and independent laboratories. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1250 Determined that neither smoking nor high cholesterol altered thermoregulation during exercise in hot conditions. Intermittent exercise did not alter the ability of a soldier's body to tolerate heat under conditions where sweat cannot evaporate to cool the body (known as uncompensable heat, such as in protective overgarments). This effort will help lead to the development of guidelines to maintain performance under adverse environmental conditions.
- 1035 Improved hydration guidelines for prevention of heat stress. The improved guidelines include conditions for over hydration and for low serum sodium levels. These improved guidelines will reduce serious illness produced by over-hydration, without reducing protection against environmental injury.
- 1144 Modeled the effect of the delivery of caffeine to mitigate sleep inertia and optimize vigilance. This will lead to the development of pharmacological strategies to optimize aviator performance.
- 777 Determined the effects of modafinil on the performance of sleep-deprived aviators, including negative potential side effects such as nausea and vertigo. This has led to the identification of adverse reactions to aviator performance caused by pharmacological interventions using this drug.

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602787A - Medical Technology**

PROJECT

**879****FY 2000 Accomplishments (Continued)**

- 957 Completed the development of the Total Accident and Incident Health Objectives Database. This is an epidemiological tool to track health behaviors and fitness levels and their relation to illness and injuries resulting from training and deployment. This tool will lead to accurate prediction of soldier fitness and performance levels.
- 700 Conducted a study to assess the utility of the Army's body fat standards as an indicator of health risk for cardiovascular disease leading to the development of guidelines which will positively impact the health of all soldiers.
- 964 Described the workload of senior leaders using biostatus monitors. Peaks and depressions in activity and sleep over seven consecutive days were observed that indicated critical periods of optimum cognitive performance. This research provides preliminary evidence for effects of cumulative stress on senior leader performance.
- 1065 Pursued potentially sensitive and easily identifiable behavioral markers for predicting Acute Mountain Sickness leading to the development of effective countermeasures.

Total 7892

**FY 2001 Planned Program**

- 2525 Simulate cardiovascular parameters and body fluid shifts to better predict initial stages of heat injury and to model effects of dehydration, which will positively impact soldier readiness through early identification of heat stress injury.
- 1731 Explore the potential of low dose amphetamines to mitigate sleep inertia and optimize vigilance in aviators leading to the development of fatigue countermeasures for aviators during sustained operations.
- 1000 Create statistical techniques to pattern behavioral changes between soldiers, to predict stress responses in deployed soldiers and optimize soldier performance.
- 479 Demonstrate specific economic benefit to behavioral interventions to reduce unintended pregnancy and sexually transmitted diseases in new military accessions. This research will provide an analysis of a behavioral intervention program.
- 600 Determine effects of mediators of soft tissue inflammation on acute mountain sickness. This will allow the formulation of effective countermeasures.
- 725 Transition a Spatial Disorientation in-flight pilot demonstration into the Initial Entry Rotary Wing training program. This demonstration will provide pilots insight into the effects of in-flight disorientation and corrective measures for its prevention.
- 1150 Use biomechanical research techniques to establish medical criteria to optimize efficiency and ensure safety of new individual soldier equipment for use by equipment developers (WC).

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602787A - Medical Technology**

PROJECT

**879**

## FY 2001 Planned Program (Continued)

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

Total 8361

## FY 2002 Planned Program

- 1197 Identify possible genetic markers of heat injury susceptibility. The results of this research will optimize the ability of the Objective Force to operate in all environments.
- 1360 Test FDA approved drugs that induce sleep without suppressing slow-wave sleep. This research will develop medical countermeasures to sustain performance when the opportunity for adequate rest is impaired or impossible due to combat conditions.
- 1050 Determine the role of the sympathetic nervous system in altitude acclimatization to improve monitoring of interventions that may accelerate adaptation to altitude. This research will reduce injury due to deployment to high altitude environments.
- 1290 Begin longitudinal studies of deployment stress in Reserve and National Guard units deploying to engage in Security and Support Operations (SASO) efforts. This research will allow the soldier to more adequately address the stress of the increased number of deployments to support peacekeeping and humanitarian mission deployments.
- 1190 Determine the impact of deployment tempo on the health of the military family.
- 1280 Determine if current Acute Mountain Sickness medication, acetazolamide, has the detrimental effect of reducing physical exercise performance.
- 1380 Evaluate new, non-pharmacological methods to enhance alertness based on ambulatory monitoring technologies.

Total 8747

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602787A - Medical Technology**

PROJECT  
**977**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
977 EMERGING INFECTIOUS DISEASES	0	6893	7000	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The scientific and technical objectives of this project is to focus on accelerating development of infectious disease threat countermeasures necessary to support operations in nonindustrialized countries and those in which infrastructure has been damaged or destroyed. It will also fund the necessary research to counter the military operational impact of emerging infectious diseases. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Project not funded in FY 2000.

**FY 2001 Planned Program**

- 6688 Evaluate modified virus as carrier vehicle for administration of candidate malaria vaccines to increase immune response. Perform molecular re-engineering to reduce toxicity of two antimalarial drug candidates.  
Seek proteins measurable in blood that may reflect immune responses to infection with diarrheal disease organisms, or dengue fever virus, for rapid testing of vaccine candidates.  
Perform gene sequencing of infectious organisms to assist in designing scrub typhus vaccine. Produce genetically engineered strains of meningitis in order to identify improved vaccine candidates.
  - 205 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 6893



**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**PE NUMBER AND TITLE  
**0602787A - Medical Technology**PROJECT  
**977****FY 2002 Planned Program**

- 7000 Begin animal testing of viral-carrier malaria vaccine candidates. Further test efficacy of molecular-modified antimalarial drugs, including assessment of ease of manufacture.  
Refine methods for rapid isolation and quantitative assessment of circulating proteins indicative of malaria and dengue fever immunity.  
  
Develop scrub typhus vaccine candidates based on gene sequencing efforts. Begin testing of genetically engineered meningitis strains.
- Total 7000

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

June 2001

<b>BUDGET ACTIVITY</b> 2 - APPLIED RESEARCH			<b>PE NUMBER AND TITLE</b> 0602805A - Dual Use Application Program						<b>PROJECT</b> 105	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
105 DUAL USE APPLICATIONS PROGRAM	9407	10061	10045	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE:** This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

The goal of this program element (PE) is to apply the Dual Use Science and Technology (DUST) Program process throughout Army agencies to leverage Army S&T development funds by partnering with the private sector in the development of technologies having both military and commercial applications. The focus of the Dual Use Science and Technology Program is primarily shorter-term military and commercial applications. However, the Program also has a longer-term impact on the transformation to the Objective Force. 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 (more than 50%). The sponsoring agency then provides half of the government cost (less than 25%), with the remainder coming from this PE (less than 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 creates incentives for 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 leverages Army S&T funds and reduces costs for end items by paralleling the development of commercial products. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. Program policy is established by the Office of the Secretary of Defense (OSD), office of the Director, Defense Research and Engineering, and is managed within the Army by the Office of the Deputy Assistant Secretary of the Army for Research and Technology. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

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

June 2001

BUDGET ACTIVITY

**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE

**0602805A - Dual Use Application Program**

PROJECT

**105**

## FY 2000 Accomplishments (Continued)

- 9407 - Provided up to 25% of funding proposed by industry to support dual use technology development. The FY00 solicitation yielded 87 proposals, from which 11 proposals were selected in the following Focus areas: Affordable Sensor Technology - Miniature Electron Bombarded Active Pixel Sensor, Low Light Level Camera, and Long Range Eyesafe Laser Imaging; Weapons Sustainment - High Pressure Food Processing Low Acid Foods; Increased Situational Awareness; Advanced Materials And Manufacturing - Manufacture of Single Crystal Tungsten Alloys; Electrokinetic Phytoreclamation; Information And Communications- Enhanced Terrestrial Personal Computers Technology for Tactical Applications; Distributed Mission Training - Rapid Command and Control Data Visualization and Decision Making via War Gaming Technology; Advanced Propulsion, Power, And Fuel - Fuel Cell Hybrid Electric Vehicle; Medical And Bioengineering - A Portable High-Throughput System for Biological Sample Preparation; An Intra-Operative Acoustic Hemostasis Device for Trauma Care; Development of Arrayable Electronic System for Identification of Biological Warfare and Infectious Disease.

Total 9407

## FY 2001 Planned Program

- 9762 Provides up to 25% of funding proposed by industry to support FY01 dual use technology development. The FY01 solicitation yielded 60 proposals, from which 19 proposals were selected in the following Focus areas: Weapons Sustainment - Log Command and Control (C2) Platform Telediagnosics; Manually Cranked Battery Charger; Affordable All-weather Rotocraft-Icing Protection System; Affordable Rotorcraft Structures; Advanced Materials And Manufacturing - Chemical/Biological (CB) Protective Clothing Based on Novel Membranes; Nanofibers for Chemical Protective Clothing Systems; Information And Communications - Embedded Short Range Wireless Networked Interconnect for Soldier Communications System; Information Processing (IP) Quality of Service-Mechanisms for Dynamic Mobile Heterogeneous Wireless Environment; Universal Personal Communication System/Mobile Satellite Services (PCS/MSS)Handset; Modulation Independent Turbo Codec; Advanced Propulsion, Power, And Fuel - Allison Hybrid Light Armored Vehicle and Civilian Heavy Hybrid Application; Simulation-based Design and Demonstration of Next Generation, Advanced Diesel Technology; Development of Advanced NiMH Battery for Heavy Duty Hybrid Electric Vehicles (HEV)Applications; High Efficiency Alternator & Climate Control System; Medical And Bioengineering - The Application of Electrode Arrays for the Development of a Rapid, Multiplexed Detection System for Biological Warfare and Infectious Disease; Development of a Subunit Vaccine for the Prevention of Campylobacter Disease; Dev. of a Dengue Virus Tetravalent DNA Vaccine Using Lysosome Associated Membrane Protein (LAMP)and Controlled Release Technologies; Development of a Live Attenuated Vaccine for the Prevention of Enterotoxigenic (ETEC) Diarrhea; and Microwave Sterilization.
- 299 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 10061

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

June 2001

BUDGET ACTIVITY  
**2 - APPLIED RESEARCH**

PE NUMBER AND TITLE  
**0602805A - Dual Use Application Program**

PROJECT  
**105**

**FY 2002 Planned Program**

- 10045 - Provides up to 25% of funding for dual-use technology projects proposed by industry. Focus areas for Army topics in FY02 are anticipated to be: Affordable Sensors; Weapons System Sustainment; Advanced Propulsion, Power & Fuel Efficiency; Information & Communications Systems; Medical & Bioengineering Technologies; Distributed Mission Training; Advanced Materials & Manufacturing; and Environmental Technologies.

Total 10045

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	9924	10154	10447	0
Appropriated Value	10000	10154	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-267	0	0	0
c. Omnibus or Other Above Threshold Reduction	-41	0	0	0
d. Below Threshold Reprogramming	-250	0	0	0
e. Rescissions	-35	-93	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	-402	0
Current Budget Submit (FY 2002/2003 PB )	9407	10061	10045	0

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	36984	21768	60332	0	0	0	0	0	0	0
242 AIRDROP EQUIPMENT	1834	2309	2928	0	0	0	0	0	0	0
393 MIL OPS IN URBAN TERRAIN (MOUT)	19546	3839	13874	0	0	0	0	0	0	0
543 AMMUNITION LOGISTICS	757	782	804	0	0	0	0	0	0	0
545 FORCE PROJECTION LOGISTICS	0	0	5000	0	0	0	0	0	0	0
557 BIOSYSTEMS TECHNOLOGY	5729	4954	0	0	0	0	0	0	0	0
594 METROLOGY & CALIB	955	1487	0	0	0	0	0	0	0	0
C07 JOINT SERVICE COMBAT FEEDING TECH DEMO	2036	2147	2216	0	0	0	0	0	0	0
J50 FUTURE WARRIOR TECHNOLOGY INTEGRATION	6127	6250	35510	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE:** This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

This Program Element (PE) develops and demonstrates technologies to: enhance dismounted soldier system capabilities by reducing the logistics burden on the battlefield; decreasing operation and sustainment (O&S) costs; and improving ammunition logistics system performance. The Future Warrior Technology Integration project (J50) has been accelerated to better align with Objective Force needs. Objective Force Warrior (OFW) is a leap-ahead integrated soldier system providing the next generation of capabilities beyond Land Warrior, and is projected to be fielded a decade after Land Warrior. OFW focuses on a systems engineered, innovative approach to achieve revolutionary capabilities, not incremental improvements. A competitive multiple contractor strategy will foster innovation and reduce risk to bring enhanced capabilities to the warfighter. OFW will provide an ultra-lightweight, stealthy armored suit, integrated with multi-functional sensors, weapons and proactive medical capabilities. The OFW will have connectivity to other dismounted personnel, and robotic air/ground platforms for improved situational understanding. The intent of OFW is to provide the dismounted soldier with combat overmatch capabilities for the full spectrum of Objective Force missions. The Military Operations in Urban Terrain (MOUT) project (393) consists of an Advanced Concept Technology Demonstration (ACTD) executing from FY98 to FY02, and a second effort initiated in FY02 to develop robotic UAVs and UGVs and other technologies for urban and complex environments. The MOUT ACTD assesses the military utility of Commercial and Government Off-the-Shelf technologies and products, and integrates selected technologies into a "System of Systems" for Soldiers and Marines operating in urban environments. The MOUT supports the Army Transformation by developing new tactical capabilities, based on validated warfighter needs and provide better communications and greater lethality, mobility, and force protection in the urban environment, increasing our warfighting options and changing the

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603001A - Warfighter Advanced Technology**

face of urban battle at the tactical level. The Joint Service Combat Feeding Technology project (C07) demonstrates technologies for military combat feeding systems and combat rations to include processing, preservation, packaging and equipment and energy technologies to reduce the logistics footprint while enhancing warrior mental and physical agility. The Ammunition Logistics project (543) demonstrates technology that optimizes weapon system rearm, ammunition packaging/palletization, explosives safety, material handling equipment, and ammunition throughput/management for improved munitions availability and survivability. The Force Projection Logistics project (545) will demonstrate a system of objective logistics simulations that relates combat performance to logistics requirements to demonstrate the effect of strategic policy and decisions on the size, cost, and effectiveness of the deployed force. The Airdrop Equipment project (242) provides enhancements to rapid deployment and force projection capability by maturing and demonstrating technology required for dropping cargo to precise locations from higher altitudes, greater offset distances and higher speeds, resulting in increased survivability of aircraft and crews, and increased probability that materials delivered will land in a usable condition. This PE supports the Army Transformation in the areas of improved dismounted soldier capabilities (projects J50 and 393), logistics footprint reduction (projects C07, 543 and 545) and rapid deployment (project 242). Contractors performing the work for this PE include: Aerovironment, CA; Battelle, OH; Innolog, MA; General Technical Services, NJ; Motorola, AZ; MRJ, FL; Rafael, Israel; Veridian, Canada; Exponent, CA; Arthur D. Little, MA; Irvin Aerospace Inc., CA; Vertigo, Inc., CA; Tecogen, MA; United Technologies, FL; Giordano Automation, NJ; and InterVision, VT; STI, Inc., OH. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program adheres to Tri-Service Reliance Agreements on clothing, textiles, food, and explosive ordnance disposal with oversight and coordination provided by the Joint Directors of Laboratories through the Warrior Systems Technology Base Executive Steering Committee. The program also follows guidelines of the Department of Defense (DoD) Human Systems Technology Area Review and Assessment (TARA) Review process. Work in this PE is related to and fully coordinated with efforts in PE 0602786A, and DARPA Small Unit Operations projects. The ammunition logistics project is related to PE 0602624A and PE 0603004A. This PE contains no duplication with any effort within the military departments. Work is performed by the Natick Soldier Center, the Aviation and Missile Command, and the Simulation, Training and Instrumentation Command.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	44831	15469	17268	0
Appropriated Value	45287	21969	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-954	0	0	
c. Omnibus or Other Above Threshold Reductions	-146	0	0	
d. Below Threshold Reprogramming	2	0	0	
e. Rescissions	-205	-201	0	
f. OSD Re-alignment	-7000	0	0	
Adjustments to Budget Years Since FY2001 PB	0	0	43064	
Current Budget Submit (FY 2002/2003 PB )	36984	21768	60332	0

Change Summary Explanation: Funding - FY 2000: Congressional adds were received for Metrology (+1000) and Biosystems Technology (+6000).  
 - Metrology funded development of national and military aerosol particle standards for DoD gas mask testers; constructed initial Army microwave calibration standards; developed technology to ensure consistency and accuracy of DoD microwave measurements generated by vector network analyzers.  
 - Biosystems Technology funded research on phyto remediation (use of plants) to clean polychlorinated biphenyls (PCB) contaminated soils; initiated research to evaluate the anti-oxidant and anti-microbial properties of taro and its potential in bread and carbohydrate-based food products; funded

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603001A - Warfighter Advanced Technology**

research on converting sugar cane and other crop starch-based by-products into fuel.

FY 2001 Congressional adds were received for Metrology (+1500) and Biosystems Technology (+5000).

- Metrology - to demonstrate and analyze standards for gas mask calibration testers; aerosol particles; microwave and radiation calibration systems.
- Biosystems Technology - for demonstration of biosystems technologies.

Note: FY 2000 to FY 2001 reduction is due to the conclusion of the primary MOUT ACTD efforts that resulted in the culminating demonstration in September 2000.

FY 2002: Funds added for Objective Force technologies for soldier systems (+28000);  
funds added for development of robotics for urban and complex environments (+10000);  
funds added for embedded training (+5000).

FY 2003: Funds added for Objective Force technologies for soldier systems (+30000).



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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603001A - Warfighter Advanced Technology</b>				PROJECT <b>242</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
242 AIRDROP EQUIPMENT	1834	2309	2928	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project focuses on the maturation and demonstration of equipment and innovative techniques for aerial delivery of cargo and personnel. This is a key capability for rapid force projection and global precision delivery, particularly into hostile areas as envisioned in the Army Vision for the Objective Force. Precision airdrop can provide a long-range, autonomous airdrop capability, with the option to deliver separate and distinctive payloads to multiple locations. Capitalizing on advances in decelerator, guidance and sensing (e.g., Global Positioning System (GPS)), and wind sensing technologies, precision airdrop systems have the ability to be deployed from high altitudes (up to 25,000 ft) and to deliver payloads with better accuracy, i.e. a 100 meter Circular-Error-Probable (CEP). Near term capabilities envisioned are delivery of 10,000 lbs. in the 20-40 km offset range and extended range delivery of 500-2000 lbs. from 100 km offset (using powered glide augmentation), both with 100 meter CEP accuracy. Delivery from high altitudes and large offset distances improves cargo/personnel and aircraft survivability. The efforts in this project support the Army Transformation in the area of rapid deployment. This project is managed by the US Army Natick Soldier Center, Natick, MA. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1834 - Identified and analyzed candidate systems for an efficient, long range 10,000 lb. payload autonomous airdrop resupply capability.
- Total 1834

**FY 2001 Planned Program**

- 2252 - Design full-size prototype pneumatic/airbag system to provide a roll-on/roll-off quick airdrop capability for a 20,000 lb. payload (STO Program).
    - Demonstrate prototype 10,000-12,000 lb. pneumatic and airbag systems and finalize design of 20,000 lb. system.
    - Fabricate components and conduct scale model testing for the 20,000 lb. payload Roll-on/Roll-off system.
  - 57 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 2309

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

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BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**242**

## FY 2002 Planned Program

- 2928 - Demonstrate the technology for a roll-on/roll-off capability for 15,000-20,000 lb. payload providing a 60% decrease in labor intensive rigging (STO Program) and transition technology to PM-Soldier Support for Engineering, Manufacturing and Development.
  - Design and evaluate (radio controlled) a 1/4-scaled prototype high altitude parachute control system.
- Total 2928

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**393**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
393 MIL OPS IN URBAN TERRAIN (MOUT)	19546	3839	13874	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Military Operations in Urban Terrain (MOUT) project is comprised of an ACTD and an effort on robotic and other technology for urban and complex environments. The ACTD assesses the military utility of Commercial Off-the-Shelf and Government Off-the-Shelf (COTS/GOTS) technologies and products, and integrates selected technologies into a "System of Systems" concept for dismounted warriors operating in urban environments. It supports the Army Transformation by focusing on timely development of solutions for conducting military operations in the urban environment. This operating environment is recognized as the most likely battlefield of the 21st century, and the environment for which our military forces are least prepared and have the least advantage. Program emphasis is technologies based on validated warfighter needs in the areas of Command, Control, Communications, Computers and Information (C4I); Lethality; Engagement; and Force Protection. The program develops and evaluates operational concepts and Tactics, Techniques and Procedures (TTPs) enabled by these technologies to provide a comprehensive package for operational employment. Experiments are conducted using Army and United States Marine Corps (USMC) operational forces to assess the military utility and to develop the appropriate operational concepts and TTPs. A complete package of successful technologies and TTPs are turned over to operational units and supported for two years (FY 2001 and FY 2002), providing an enhanced interim operational capability. The most promising technologies are transitioned to DoD acquisition programs for follow-on acquisition and fielding after completion of the ACTD Culminating Demonstration in FY 2000. The MOUT ACTD is a joint Army/Marine Corps program. In FY02, a new effort was funded to demonstrate robotic and other technologies to enhance communications and situational awareness in MOUT environments. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP) and is managed by the U.S. Army Natick Soldier Center, Natick, MA.

**FY 2000 Accomplishments**

- 7000 - Managed, coordinated and executed FY 2000 MOUT ACTD program.
  - Completed integration/modifications resulting from joint company level experiments to remaining MOUT ACTD technologies.
  - Conducted force effectiveness analyses to determine higher echelon impacts on individual soldier/small unit MOUT improvements.
- 12546 - Completed New Equipment Training (NET), and supported associated field training exercises using MOUT ACTD technologies.
  - Procured and delivered MOUT ACTD Culminating Demonstration hardware (additional quantities of MOUT ACTD technology products) to Army and USMC Experimental Forces (EXFOR).
  - Conducted Advanced Concept Excursion to investigate potential emerging MOUT related technologies in first quarter FY 2000.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**393**

## FY 2000 Accomplishments (Continued)

- Conducted Situational Awareness/Communications Excursion to assess impact of communication devices on individual soldier/small unit MOUT operations.
- MOUT ACTD Culminating Demonstration was conducted 9-21 Sep 00 at Joint Readiness Training Center (JRTC), Fort Polk, LA.
- Finalized technology transition assessments.
- Transitioned Blunt Trauma Training Munition to Army FY 2001 Soldier Enhancement Program (SEP); transitioned Mechanical Wall Breaching technology to USMC FY 2001 Marine Enhancement Program (MEP); working to transition four other requirements to appropriate Army programs for FY 2002 starts.

Total 19546

## FY 2001 Planned Program

- 1959 - Complete transitions of successful MOUT ACTD technologies to Army acquisition programs.
  - Refurbish MOUT ACTD residual hardware and transition to Army and USMC EXFOR.
  - Conduct extended military utility and technical analyses and assessments of residual hardware.
  - Collect data on refinement of MOUT TTPs and capability requirements.
  - Provide technical/engineering support operations for residual hardware during extended user evaluation (EUE) phase (FY01-FY02).
- 1766 - Extend experimentation phase of program to focus on evaluation of solutions to unfulfilled and partially fulfilled MOUT ACTD requirements, and also to undertake other key MOUT activities as directed by OSD.
- 114 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3839

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**393**

## FY 2002 Planned Program

- 3874 The MOUT ACTD is completing in FY02.
  - Complete extended military utility and technical analyses and assessments of residual hardware.
  - Complete collection of data on refinement of MOUT TTPs and capability requirements.
  - Complete providing technical/engineering support operations for residual hardware during EUE phase which ends in fourth quarter FY 2002.
  
- 10000
  - Demonstrate a soldier-portable, unmanned aerial vehicle providing real time situational awareness in complex, urban terrain.
  - Evaluate robotic platforms to demonstrate see-first, act-first capabilities in a MOUT environment.
  - Demonstrate collaborative multi-robot operations in urban terrain.

Total 13874

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603001A - Warfighter Advanced Technology</b>				PROJECT <b>545</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
545      FORCE PROJECTION LOGISTICS	0	0	5000	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures and demonstrates simulation technology to support highly deployable forces, including the full spectrum of simulation capabilities from wargaming systems to stand-alone training devices to embedded training. The products will have application for Army training, concept development, and mission rehearsal. It will provide information for material decisions and training capabilities to support future combat missions of the Objective Force. The simulation technologies will support evaluation of the effects of emerging capabilities on materiel system performance, Tactics, Techniques and Procedures (TTPs), and combat effectiveness. This project is managed by the U.S. Army Simulation, Training, and Instrumentation Command. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Program not funded in FY 2000.

**FY 2001 Planned Program**

Program not funded in FY 2001.

**FY 2002 Planned Program**

- 5000      - Demonstrate first generation simulation to be embedded in Objective Force combat vehicles to enable collaborative platoon level training.
  
- Demonstrate adaptability to multiple mission types and geographic locations to support deployable mission rehearsal and training.

Total    5000

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603001A - Warfighter Advanced Technology**

PROJECT

**545**

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603001A - Warfighter Advanced Technology</b>					PROJECT <b>C07</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
C07 JOINT SERVICE COMBAT FEEDING TECH DEMO	2036	2147	2216	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Joint Service Combat Feeding Technology Demonstration project matures and demonstrates nutritionally advanced rations, biosensor technologies for ration contamination/wholesomeness assessment, and logistically streamlined combat feeding systems with enhanced fuel efficiencies to decrease the combat feeding logistics tail. The project focuses on demonstrations of advances in combat rations technology, materials, energy utilization, and heating technologies to provide efficient and effective 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 supports the Army Transformation in reducing the logistics footprint. This project is a DoD program for which the Army has Executive Agent responsibility and is managed by the U.S. Army Natick Soldier Center, Natick, MA. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 812 - Conducted studies to evaluate different classes of ethylene inhibiting and blocking products to extend the shelf-life of fresh fruits and vegetables for military feeding systems.
  - Tested concept products for family of novel, shelf-stable breakfast items for combat rations; completed ration menu design. Transitioned to Fielded Individual Ration Improvement Program (FIRIP) and Fielded Group Ration Improvement Program (FGRIP).
  - Matured and demonstrated formulas and evaluated packaging alternatives for improved shelf-stable pouch bread for field feeding. Transitioned to FIRIP.
  - Completed demonstration of interactive packaging technologies which maintain initial ration component quality while extending shelf-life, and transitioned to fielded ration systems.
- 687 - Completed interactive studies of potential ration packaging films for irradiated ration components and supported development of additional American Society of Testing and Materials (ASTM) standards in line with acquisition streamlining initiatives.
  - Completed wave field uniformity demonstration of revolutionary radio frequency processed group ration components which significantly reduce degradative effects of conventional thermal processing, and coordinated data for FDA and USDA regulatory process approval.



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**C07**

**FY 2000 Accomplishments (Continued)**

- Demonstrated the effects of acoustical matching with product type, packaging material, and hydrodynamic shock waves to improve meat component texture for combat ration optimization.
- 537 - Matured and demonstrated rudimentary modeling capability within the Dynamic Nutrition Model to establish a baseline of an individual's "available energy" to perform select military tasks.
- Conducted small-scale technical demonstration to downselect miniaturized biosensor probe to ensure microbiological/chemical safety of both fresh prepared and packaged rations, and prepared for user/field testing of the system.

Total 2036

**FY 2001 Planned Program**

- 661 - Integrate Superheated Liquid Injected Cogeneration (SLIC) technology in an experimental field kitchen; demonstrate the quiet and reliable power and mix of high and low temperature heat at 1/3 the fuel consumption of conventional field kitchens. Transition to System Development & Demonstration (SDD) program, Battlefield Kitchen.
- Design and fabricate Self Heated Group Ration (SHGR) technology to support future warfighter missions. Conduct limited technical demonstration to determine military value, and features needing improvement. Transition to Remote Unit Self Heating Meal.
- 1455 - Demonstrate portable combat ration biosensor system prototype for validating the wholesomeness and safety of combat rations, and transition to Veterinary Command.
- Mature and evaluate prototype delivery systems to extend the shelf-life of fresh fruit and vegetables for military feeding systems reducing demand for replenishment supplies.
- Extend the Dynamic Nutrition Model to track an individual's "level of fatigue" based on "available energy" minus energy expenditures (task performance) to optimize combat performance.
- Conduct testing for improved United States Air Force (USAF) tube food prototypes for high altitude reconnaissance to maintain high levels of pilot cognitive skills.
- Complete assessment of irradiated foods with enhanced safety to extend shelf-life, increase variety, and reduce weight and cube of combat rations.
- Demonstrate, using soldiers as evaluators, improved pouch bread and transition to SDD.
- 31 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2147

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**C07**

**FY 2002 Planned Program**

- 823 - Incorporate Dynamic Nutrition Model outputs into the Integrated Unit Simulation System Model to assess the influence of nutritional initiatives on combat outcomes.  
 - Test and evaluate sensors and other components of the computer-based externally monitored ration quality system. Transition to Program Definition and Risk Reduction (PDRR) for producibility testing.  
 - Prepare protocols for testing performance enhancing nutrient delivery system prototypes. Validate efficacy tests for performance enhancing ration components.  
 - Test/evaluate prototype "First Strike" ration system for modularity and ability to provide minimal sustaining nutrients during first 1-3 days of conflict.
  
  - 558 - Evaluate services' selected Class I supply/requisition/distribution related technology concepts during an appropriate large-scale field exercise.  
 - Conduct demonstration/evaluation of enhanced feeding system prototypes for extended reconnaissance flights with Air Force flight surgeons. Transition to USAF.
  
  - 580 - Mature and evaluate non-foil packaging system prototypes for microwave/radio frequency sterilized ration components.  
 - Optimize formulations and initiate storage studies of compressed ration entree prototypes capable of reducing weight and volume while maintaining A-ration quality.
  
  - 255 - Integrate optimized packaging, heater, and food for the SHGR prototype and complete final demonstrations, showing reduced logistics associated with field kitchens (90% reduction in manpower, weight and cost). Transition to SDD.
- Total 2216

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603001A - Warfighter Advanced Technology</b>						PROJECT <b>J50</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
J50 FUTURE WARRIOR TECHNOLOGY INTEGRATION	6127	6250	35510	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This program element matures and demonstrates leap-ahead technologies and systems for the Objective Force Warrior (OFW), with emphasis on integrated, multi-functionality. This effort provides the dismounted soldier the same combat-overmatch, skip-a-generation capability the Future Combat Systems (FCS) bring to the Maneuver portion of the Objective Force. OFW will employ open system architectures and high-risk/high payoff technologies to yield an ultra-lightweight, stealthy armored suit, integrated with multi-function sensors, weapons and medical capabilities. The goal is to achieve a leap-ahead advance over Land Warrior in the areas of survivability, soldier lethality, and agility - to operate for extended periods under arduous conditions, with minimal loss in physical capabilities from fatigue, stress, and hardship. This soldier system-of-systems can also be connected to other dismounted personnel and micro-robotic air/ground platforms to form adaptive, distributed sensor networks for better situational understanding of local environments. The program will emulate the FCS program by having industry and government teams perform the system integration of the revolutionary technologies for the demonstrator soldier system. Concurrent maturation of technologies and their manufacturing processes will be performed to ensure system-of-system affordability, with reduced sustainment costs. To achieve this goal, current future warrior projects has been redirected, and funding brought forward, to achieve the desired capability within the decade. Funding has been increased in FY 2002 and FY 2003 for a competitive concept exploration phase and a preliminary design phase, respectively. An advanced technology demonstration (FY 2004-2007) will provide an integrated system-of-systems soldier demonstrator. The competitive strategy brings greater innovation and reduced risk in the soldier system demonstrator, an improved system Technical Readiness Level, and greater capabilities to the Warfighter.

This project also demonstrates advanced technologies that address weight, power, fightability, and affordability issues related to Land Warrior (LW) during FY 2000-2003. It completes the maturation and integration of integrated navigation, system voice control and combat identification technologies into developmental and future warrior systems. It also will develop tethered hardware and software interfaces between developmental warrior systems and critical lethality subsystems, such as the Javelin anti-tank weapon system. The project will advance the baseline developmental warrior systems by maturing and demonstrating the following technology upgrades for transition as Pre-Planned Product Improvements: Javelin interfaces with less than three frame video latency, an integrated medical physiological status monitoring system, and emerging commercial electronics and software that require 10% less power than the baseline LW. The project will participate in Defense Advanced Research Projects Agency (DARPA) Small Unit Operations(SUO)/Situation Awareness Systems (SAS) evaluations to measure SUO/SAS technologies performance within an integrated soldier system.

The US Army Natick Soldier Center, Natick, MA, manages this project. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**J50**

**FY 2000 Accomplishments**

- 3955 - Completed integration, demonstration and transition of integrated navigation to the LW System Development and Demonstration (SDD) program. Integrated navigation capability was included in the LW version 0.6 used in the Joint Contingency Force Advanced Warfighting Experiment in FY 2000. Combat Identification (ID) transition delayed until FY01, due to changes in the LW EMD program.
  - Prepared transition documentation and completed planning and budgeting with appropriate Program Managers.
  - Initiated an engineering review and analysis of DARPA SUO technologies to assess feasibility and alternatives for integration with current and future warrior systems.
  - Investigated the ability of the LW developmental warrior system processing capability, user interface and the Medium Thermal Weapon Sight to be used to perform functions currently performed by the Javelin Command Launch Unit (CLU). Laid out a program plan for a FY 2002 Technology Demonstration with LW, Javelin and a "slim" CLU.
- 2172 - Developed a robust warrior system modernization strategy and program linkages to align future dismounted soldier systems with the new Army vision for a soldier-centric Objective Force. This strategy includes concepts for LW block upgrade by 2010 to interface with Future Combat Systems (FCS) for the Objective Brigade deployment. This also includes identification of enabling technologies that will feed warrior system concepts out to 2020.
  - Demonstrated breadboard systems that showed potential capabilities and integration concepts for 2010 and 2025 timeframe warrior systems.
  - Initiated concept exploration of advanced combat uniform and integration platform including construction of concept prototypes.

Total 6127

**FY 2001 Planned Program**

- 4349 - Integrate, demonstrate and transition an improved integrated navigation technology and Combat ID capability to the LW version 1.0 SDD system. Establish baseline performance capability and use patterns of initial developmental prototype warrior system to aid in technology investment decisions.
  - Mature and integrate advanced technology upgrades (e.g., Javelin integration, medical physiological status monitoring, low power electronics and software, system voice control) for developmental warrior systems.
  - Assess performance of upgraded developmental warrior system and conduct user evaluations.
- 1750 - Conduct user needs analysis and explore alternative integration concepts for advanced combat uniform and integration subsystem. Design and build breadboard systems for future laboratory analysis and user feedback.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603001A - Warfighter Advanced Technology**

PROJECT

**J50**

## FY 2001 Planned Program (Continued)

- Investigate viability of integrating body worn textile based antennas into future soldier system to improve communications and reduce snagging experienced with current metal whip antennas.

- Design state-of-the-art prototype microclimate conditioning (MCC) component, to include a blower for ventilation and cooling unit for active personnel cooling. The prototype MCC component design will be optimized to provide adequate ventilation and cooling while minimizing the weight and power penalties.

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

Total 6250

## FY 2002 Planned Program

- 4948 - Upgrade prototype developmental warrior system with technology that provides interoperability with tactical engagement simulation to provide a "train as you fight - fight as you train" capability.

- Participate in DARPA SUO/SAS evaluations to assess the viability of integrating selected technologies from these programs into future warrior systems.

- Demonstrate integration of LW capabilities with Javelin anti-tank weapon system using a significantly smaller, lighter weight prototype command launch unit to provide a leap in dismounted soldier lethality, minimizing weight penalties.

- Demonstrate and transition first generation physiological/medical monitoring system and system voice control capabilities integrated with LW system architecture to the LW SDD program.

- Integrate low power electronic components/software (e.g., displays, sensors) and high density power sources into prototype warrior systems. Evaluate capability enhancements and potential for 10% reduction in power requirements.

- 2562 - Conduct user juries, laboratory and limited field evaluations of the advanced combat uniform breadboard prototypes. Iterate design concepts based on user feedback, lab/field evaluation results, and emerging technology availability.

- Develop lightweight active cooling, heating and ventilation prototypes with integrated high density power source for technical and user assessments.

- Investigate connector interfaces for textile based data/power buses, sensors, and/or miniaturized electronics for integration into a personal body local area network for future soldier systems.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603001A - Warfighter Advanced Technology**

PROJECT  
**J50**

## FY 2002 Planned Program (Continued)

- 28000 - Program will achieve innovation through competition - combined Industry/Government teams will compete during the concept exploration phase to reduce risks and provide greater capabilities to the warfighter.
  - OFW will pursue greater innovation in system design to achieve superior warrior survivability, lethality and sustainment through open system architects and high-risk/high payoff technologies to yield an ultra-lightweight, stealthy armored suit, integrated with multi-function sensors, weapons and medical capabilities.
  - The program will develop an integrated soldier system-of-systems with robust connectivity to other dismounted personnel, micro-robotic air/ground platforms, distributed sensor networks and FCS to achieve access to remote fires and better situational understanding.

Total 35510

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

June 2001

**BUDGET ACTIVITY**  
**3 - ADV TECHNOLOGY DEV**

**PE NUMBER AND TITLE**  
**0603002A - Medical Advanced Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	74381	221085	17541	0	0	0	0	0	0	0
800 TELEMEDICINE TESTBED	0	4315	1664	0	0	0	0	0	0	0
804 PROSTATE CANCER RSCH	2864	3963	0	0	0	0	0	0	0	0
810 IND BASE ID VACC&DRUG	7728	7995	8664	0	0	0	0	0	0	0
814 NEUROFIBROMATOSIS	0	16844	0	0	0	0	0	0	0	0
815 NATIONAL MEDICAL TESTBED	0	14862	0	0	0	0	0	0	0	0
818 ADVANCED CANCER DETECTION CTR	3341	3467	0	0	0	0	0	0	0	0
819 FLD MED PROT/HUM PERF	193	1676	556	0	0	0	0	0	0	0
840 COMBAT INJURY MGMT	5672	6362	2657	0	0	0	0	0	0	0
893 TISSUE REPLACEMENT	0	991	0	0	0	0	0	0	0	0
923 PROSTATE DIAGNOSTIC IMAGE	7160	0	0	0	0	0	0	0	0	0
929 ARTIFICIAL LUNG TECHNOLOGY	955	0	0	0	0	0	0	0	0	0
934 VOLUME ANGIOCAT	5729	5945	0	0	0	0	0	0	0	0
937 NERVOUS SYSTEMS STUDIES	0	5945	0	0	0	0	0	0	0	0
938 TISSUE ENGINEERING	0	2279	0	0	0	0	0	0	0	0
940 EPIDERMOLYSIS BULLOSA	955	2972	0	0	0	0	0	0	0	0
941 DIABETES RESEARCH	13365	13872	0	0	0	0	0	0	0	0
945 BREAST CANCER STAMP	1329	0	0	0	0	0	0	0	0	0
969 ALCOHOLISM RESEARCH	6684	8423	0	0	0	0	0	0	0	0
970 ENZYMATIC WOUND DISINFECTANT	1909	0	0	0	0	0	0	0	0	0
971 HIV RESEARCH	11247	9908	0	0	0	0	0	0	0	0
972 LASER VISION CORRECTION	1909	5449	0	0	0	0	0	0	0	0
973 RECOMBINANT VACCINE RESEARCH	1909	5945	0	0	0	0	0	0	0	0
974 SMART AORTIC RESEARCH	1432	0	0	0	0	0	0	0	0	0
975 PROTECTION AGAINST EMERGING INFECTIOUS DISEASES	0	3938	4000	0	0	0	0	0	0	0
97A BIOSENSOR RESEARCH	0	2478	0	0	0	0	0	0	0	0
97B BLOOD SAFETY	0	6936	0	0	0	0	0	0	0	0

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603002A - Medical Advanced Technology</b>								
97C	CANCER CENTER OF EXCELLENCE	0	991	0	0	0	0	0	0	0	0
97D	CENTER FOR AGING EYE	0	1982	0	0	0	0	0	0	0	0
97E	CENTER FOR PROSTATE DISEASE RESEARCH	0	7431	0	0	0	0	0	0	0	0
97F	CHRONIC DISEASE MANAGEMENT	0	4459	0	0	0	0	0	0	0	0
97G	CHRONIC FATIGUE	0	1486	0	0	0	0	0	0	0	0
97H	CLINICAL ASSESSMENT RECORDING ENVIRONMENT	0	991	0	0	0	0	0	0	0	0
97I	DREAMS	0	9413	0	0	0	0	0	0	0	0
97J	ECHOCARDIOGRAM	0	1982	0	0	0	0	0	0	0	0
97K	FUNCTIONAL MAGNETIC RESONANCE IMAGING	0	495	0	0	0	0	0	0	0	0
97L	INTEGRATIVE MEDICINE DISTANCE LEARNING PROGRAM	0	793	0	0	0	0	0	0	0	0
97M	LIGAMENT HEALING	0	1486	0	0	0	0	0	0	0	0
97N	LUNG CANCER DETECTION	0	2972	0	0	0	0	0	0	0	0
97O	LUNG CANCER RESEARCH	0	4459	0	0	0	0	0	0	0	0
97P	REMOTE ACOUSTIC HEMOSTASSIS	0	3963	0	0	0	0	0	0	0	0
97Q	MICRO POSITRON EMISSION TOMOGRAPHY	0	991	0	0	0	0	0	0	0	0
97R	MOLECULAR AND CELLULAR BIOENGINEERING RESEARCH	0	595	0	0	0	0	0	0	0	0
97S	MOLECULAR GENETICS AND MUSCULOSKELETAL RESEARCH	0	7927	0	0	0	0	0	0	0	0
97T	NEUROTOXIN EXPOSURE TREATMENT	0	14862	0	0	0	0	0	0	0	0
97U	OCULAR FATIGUE MEASUREMENT	0	416	0	0	0	0	0	0	0	0
97V	POLYNITROXILATED HEMOGLOBIN	0	991	0	0	0	0	0	0	0	0
97W	SEATREAT CANCER TECHNOLOGY	0	1486	0	0	0	0	0	0	0	0
97X	SYNCHROTRON-BASED SCANNING RESEARCH	0	6936	0	0	0	0	0	0	0	0
97Y	VIRTUAL RETINAL DISPLAY TECHNOLOGY	0	3963	0	0	0	0	0	0	0	0



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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603002A - Medical Advanced Technology</b>							
97Z	TAFENOQUINE ANTIMALARIAL AGENT	0	1982	0	0	0	0	0	0	0	
98A	ARTIFICIAL HIP VOLUMETRICALLY CONTROLLED MFG	0	3468	0	0	0	0	0	0	0	

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This program element supports focused research for healthy, medically protected soldiers, and funds research consistent with the "Medical" and "Survivability" technology areas of the Objective Force. The primary goal of this program is to provide, with minimum adverse effects, maximum soldier survivability and sustainability on the integrated battlefield as well as in military operations other than war. This program element funds advanced technology development for the Department of Defense (DoD) core Vaccine and Drug Program, field medical protective devices, and combat injury management. The DoD core Vaccine and Drug Program provides, in accordance with Food and Drug Administration (FDA) regulations, drugs and vaccines for development that are effective protectants, treatments, and antidotes against military disease threats. Pilot and standard lots of candidate pharmaceutical-grade drugs, antidotes and vaccines are produced. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program element is managed by the U.S. Army Medical Research and Materiel Command. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603002A - Medical Advanced Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	73252	16512	13491	0
Appropriated Value	74539	223132	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1910	0	0	
c. Omnibus or Other Above Threshold Adjustments	-295	0	0	
d. Below Threshold Reprogramming	3039	0	0	
e. Rescissions	-992	-2047	0	
Adjustments to Budget Years Since FY2001 PB	0	0	4050	
Current Budget Submit (FY 2002/2003 PB )	74381	221085	17541	0

Change Summary Explanation: Funding - FY 2002: Funding increased in support of Project 975- Protection Against Emerging Infectious Diseases (+4000)

One-year Congressional adds without R-2A Exhibits:

FY 2001

Project 804, Prostate Cancer Research (+4000)

Project 814, Neurofibromatosis Research (+17000)

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)****June 2001**

## BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

## PE NUMBER AND TITLE

**0603002A - Medical Advanced Technology**

Project 815, National Medical Testbed (+15000)  
Project 818, Advanced Cancer Detection (+3500)  
Project 893, Wound Healing (+1000)  
Project 934, Volume AngioCAT (+6000)  
Project 937, Neuroscience Research (+6000)  
Project 938, Tissue Repair (+2300)  
Project 940, Epidermolysis Bullosa (+3000)  
Project 941, Diabetes Projects (+14000)  
Project 969, Alcoholism Research (+8500)  
Project 971, HIV Research (+10000)  
Project 972, Laser Vision Correction (+5500)  
Project 973, Recombinant Vaccine Research (+6000)  
Project 97A, Biosensor Research (+3500)  
Project 97B, Blood Safety (+7000)  
Project 97C, Cancer Center of Excellence (+1000)  
Project 97D, Center for Aging Eye (+2000)  
Project 97E, Center for Prostate Disease Research (+7500)  
Project 97F, Chronic Disease Management (+4500)  
Project 97G, Chronic Fatigue (+1500)  
Project 97H, Clinical Assessment Recording Environment (CARE) (+1000)  
Project 97I, Disaster Relief and Emergency Medical Service (DREAMS) (+9500)  
Project 97J, Echocardiogram (Far Forward Echocardiogram Device) (+2000)  
Project 97K, Functional Magnetic Resonance Imaging (+500)  
Project 97L, Integrative Medicine Distance-learning Program (+800)  
Project 97M, Ligament Healing (+1500)  
Project 97N Lung Cancer Detection (CT) (+3000)  
Project 97O, Lung Cancer Research (+4500)  
Project 97P, Remote Acoustic Homostasis (+4000)  
Project 97Q, Micro Positron Emission Tomography (+1000)  
Project 97R, Molecular and Cellular Bioengineering Research (+600)  
Project 97S, Molecular Genetics and Musculoskeletal Research Program (+8000)  
Project 97T, Neurotoxin Exposure Treatment (+15000)  
Project 97U, Ocular Fatigue Measurement (+420)  
Project 97V, Polynitroxylated Hemoglobin (+1000)

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603002A - Medical Advanced Technology**

Project 97W, SEATreat Cancer Technology (1500)  
Project 97X, Synchrotron-based Scanning Research (+7000)  
Project 97Y, Virtual Retinal Display Technology (+4000)  
Project 97Z, Tafenoquine Anti-malarial Agent (+2000)  
Project 98A, Artificial Hip Volumetrically Controlled Manufacturing (+3500)

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603002A - Medical Advanced Technology</b>					PROJECT <b>800</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
800 TELEMEDICINE TESTBED	0	4315	1664	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports the "Medical" technology area of the Objective Force by developing and demonstrating future medical concepts of operations, operational architectures, and operational requirements to support forward echelon telemedicine presence, medical command and control, and collaborative planning tools for mission planning and rehearsal. It funds development, evaluation, and demonstration of prototype advanced technology concepts and materiel for provision of enhanced Force Health Protection. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Program not funded in FY 2000.

**FY 2001 Planned Program**

- 1696 This Project is a New Start previously funded by Program Elements/Projects: 00602787A/869 and 00602787A/874.
    - Evaluate modeling and simulation capabilities to provide commanders with capabilities to tailor deploying medical forces as part of Joint Medical Operations - Telemedicine Advanced Concept Technology Demonstration (ACTD).
    - Select the leave-behind capability package that will be evaluated by the U.S. Pacific Command during the transition phase of the ACTD and refine operational concepts.
  - 2491 A non-recurring Congressional add for secure telemedicine.
  - 128 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 4315

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603002A - Medical Advanced Technology**

PROJECT

**800**

## FY 2002 Planned Program

- 1664 Field a leave-behind capability and evaluate its robustness as a follow on of the Joint Medical Operations - Telemedicine ACTD. This will allow the users to further refine the operational and materiel concepts for employment of telemedicine in deployed military environments. Refine the logistical support concepts.

Total 1664

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603002A - Medical Advanced Technology**

PROJECT  
**810**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
810 IND BASE ID VACC&DRUG	7728	7995	8664	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports the "Medical" technology area of the Objective Force by developing medical countermeasures for naturally occurring diseases that are militarily significant due to their potential impact on military operations. Medical countermeasures will protect the force from infection and sustain operations by preventing hospitalization and evacuations from the theater of operations. Intramural research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Medical Research Institute of Infectious Diseases, the Walter Reed Army Institute of Research and its overseas laboratories, and the Naval Medical Research Center and its overseas laboratories. Major contractors are the Israel Defense Force Medical Corps, Israel; Promed Trading, SA, Panama; the Armed Forces Research Institute of Medical Science, Bangkok, Thailand; and the Research Triangle Institute, Research Triangle Park, NC. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4080 Began FDA approved human clinical trials of new malaria vaccine candidates. Completed pre-clinical trials, in monkeys, of additional candidates and of alternate immunization schedules. Completed pre-clinical evaluation of candidate antimalarial drug extracted from artemisia plant.
  - 1507 Initiated human clinical trials of candidate shigella dysentery vaccine. Continued preclinical and human clinical studies, of Enterotoxigenic Esherichia coli (ETEC) and Campylobactor candidate vaccines and infections.
  - 1191 Began laboratory and field evaluations of potential new insect repellants; prepared two modified meningitis vaccines for preclinical and clinical evaluation.
  - 950 Evaluated diagnostic tests for encephalitis and hemorrhagic fever infections.
- Total 7728

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603002A - Medical Advanced Technology**

PROJECT  
**810**

**FY 2001 Planned Program**

- 4832 Initiate human trials of a malaria DNA vaccine followed by a viral delivered malaria vaccine boost. Prepare sufficient blood stage and mosquito stage malaria vaccines for preclinical animal studies and human challenge trials. Complete preclinical efficacy, dosing, and toxicology evaluations as required by the FDA for artemisinic acid, the leading candidate drug to treat multi-drug resistant and severe and complicated malaria. Manufacture other antimalarial candidates for preclinical pharmacokinetic and toxicology studies.
- 2088 Conduct human trials of a Shigella flexneri live vaccine modified to reduce reactions in recipients, oral and transcutaneous vaccine candidates for ETEC and an oral vaccine candidate for Campylobacter.
- 903 Complete a safety and immunogenicity trial of candidate Group B meningitis vaccine to identify the best formulation. Conduct a clinical trial of Hepatitis E candidate vaccine to establish safety, immunogenicity, and dosing. Produce a single serotype dengue DNA vaccine and construct a virally delivered dengue vaccine candidate for safety testing in monkeys. Evaluate a Hantavirus DNA vaccine in monkeys. Validate a rapid antibody-based test for identifying Shigella in stool samples. Conduct concept exploration on insect vector control systems by conducting field trials to evaluate a rapid test to identify dengue virus in mosquitoes.
- 172 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 7995

**FY 2002 Planned Program**

- 5025 Begin clinical safety and immunogenicity studies of multivalent DNA and multivalent protein candidate vaccines for falciparum malaria. Start clinical safety and immunogenicity testing of candidate vaccines to protect against vivax malaria. Transition to advanced development an intravenous drug formulation for the treatment of severe and complicated malaria.
- 1164 Transition to development a Shigella dysenteriae vaccine to protect against this cause of debilitating diarrhea.
- 1661 Conduct a clinical trial of the leading candidate Group B meningitis vaccine. Conduct animal studies as required by the FDA to determine efficacy of a candidate plague vaccine that was developed for biological defense in preventing naturally acquired infection with the plague bacteria.
- 814 Conduct animal trials of a candidate dengue vaccine against all four dengue serotypes and complete a phase 1 human trial of a single serotype dengue candidate vaccine. Conduct animal studies to determine the efficacy of antibodies for the treatment and/or prophylaxis of hantavirus disease.

Total 8664



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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603002A - Medical Advanced Technology**

PROJECT

**810**

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603002A - Medical Advanced Technology**

PROJECT  
**840**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
840 COMBAT INJURY MGMT	5672	6362	2657	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project addresses investigation of the treatments for weapons-induced trauma and shock due to blood loss on the battlefield as outlined in the Objective Force Medical Technology Area. The 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 candidate drug and biologic compounds and equipment to obtain data necessary for Food and Drug Administration (FDA) approval for human use. Intramural research under this project is conducted at the U.S. Army Medical Research and Materiel Command's Institute of Surgical Research, and the Walter Reed Army Institute of Research and its overseas laboratories. The major contractor is Integrated Medical Systems, Signal Hill, CA. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1725 - Conducted advanced technology development of novel methods of stopping bleeding and enhancing the resuscitation capabilities for combat medics by testing a 10-week red blood cell storage solution to reduce the logistical burden on the battlefield, by testing fibrin foam formulations to control bleeding in animal models of hemorrhage, by starting clinical testing of a blood protein with anti-inflammatory properties that are protective after hemorrhage, and by continued testing of potential neuroprotective drugs in animal models to assess brain protection following trauma.
- 560 - Conducted advanced technology development on novel methods to minimize, repair, and prevent injuries to hard and soft tissues by evaluating modes of failure of bioabsorbable versus metallic soft tissue anchors in knee joints, investigating microencapsulated anti-inflammatory dental pulp-capping agents to enhance return to duty in far-forward locations, and beginning to test methods for the early diagnosis of low blood flow in limbs in patients with burns to the extremities.
- 3387 - Conducted advanced technology development of the Life Support for Trauma and Transport (LSTAT) platform to enhance patient care and transport far forward on the battlefield. This was a FY 2000 Congressional add.

Total 5672

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603002A - Medical Advanced Technology**

PROJECT

**840**

## FY 2001 Planned Program

- 1215 - Conduct advanced technology development to evaluate novel drugs for reducing blood loss and enhancing hemostatic function in combatants wounded under severe cold conditions and test biologic agents to control massive internal bleeding. Examine methods to inactivate infectious agents in whole blood and red blood cells to enhance blood supply far forward.
- 645 - Conduct advanced technology development of devices to ease patient treatment on the battlefield. Complete the preclinical evaluation of an integrated anesthesia device to replace the outdated one currently in inventory. Perform field tests of a new, one-handed tourniquet.
- 328 - Conduct advanced technology development to establish a system for the collection of human trauma data at the locality of injury. Develop a lightweight, small device to sterilize dental instruments in the field environment to decrease logistical burden.
- 3986 - FY 2001 Congressional add to enhance and continue development of Life Support for Trauma and Transport (LSTAT).
- 188 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 6362

## FY 2002 Planned Program

- 1000 - Conduct advanced technology development to complete evaluation of drugs for reducing blood loss in cold casualties and complete study of methods for the delivery of biologic agents to control massive internal bleeding. Continue investigations to support the development of methods to inactivate infectious agents in whole blood to enhance blood supplies far forward.
- 1039 - Conduct advanced technology development of devices to ease patient treatment on the battlefield. Complete clinical trials of an integrated anesthesia device and the preclinical evaluation of a self-contained, 20-pound intensive care life support system. Complete technical testing of a personal oxygen generation system that will eliminate the need for oxygen cylinders on the battlefield.
- 618 - Conduct advanced technology development to collect human trauma data at the locality of injury. Enhance development of a lightweight, small device to sterilize dental instruments in the field environment.

Total 2657

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603002A - Medical Advanced Technology**

PROJECT  
**975**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
975 PROTECTION AGAINST EMERGING INFECTIOUS DISEASES	0	3938	4000	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The scientific and technical objectives for this project focus on accelerating development of infectious disease threat countermeasures necessary to support operations in nonindustrialized countries and those in which infrastructure has been damaged or destroyed. It will also fund the necessary research to counter the military operational impact of emerging infectious diseases. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Project not funded in FY 2000.

**FY 2001 Planned Program**

- 3821 Conduct safety, immunogenicity, and first stage efficacy testing of three candidate malaria vaccines in Thailand.  
Prepare FDA submissions for human testing of candidate vaccine against shigella, a major cause of diarrheal disease.  
Conduct field evaluations of systems to kill dengue fever-transmitting mosquitoes, and to rapidly detect malaria-infected mosquitoes.  
Further develop candidate DNA vaccine directed against hantavirus disease; explore delivery methods; produce pilot lot for initial human testing.
  
  - 117 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3938

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603002A - Medical Advanced Technology**

PROJECT  
**975**

## FY 2002 Planned Program

- 4000 Continue human testing of three candidate malaria vaccines in Thailand.  
Initiate human volunteer trials of new shigella vaccine.  
Expand scope of field trials of new mosquito-killing systems, and mosquito disease assay systems.  
Initiate human safety and immunogenicity testing of DNA vaccine candidates for hantavirus infection.

Total 4000

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603003A - Aviation Advanced Technology**

COST (In Thousands)	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cost	30739	28545	44843	0	0	0	0	0	0	0
313 ADV ROTARYWING VEH TECH	20870	14501	28102	0	0	0	0	0	0	0
435 AIRCRAFT WEAPONS	1078	3643	1794	0	0	0	0	0	0	0
436 ROTARYWING MEP INTEG	2034	3566	8120	0	0	0	0	0	0	0
447 ACFT DEMO ENGINES	6757	6835	6827	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The Aviation Advanced Technology program element (PE) provides mature technology through design, fabrication, and test of advanced rotary wing platform and mission equipment integration technologies, advanced technology engines, and integrated components to validate achievable improved performance levels for current and future DoD rotary wing vehicles (RWVs) emphasizing Army unique requirements. This PE supports the Objective Force and Joint Vision 2020. The Objective Force will require rotorcraft systems that have significantly increased/improved lift, range and survivability with an overall reduction in logistics. The critical technologies to support these capabilities will be matured through Technology Demonstrations (TDs) of rotors, active controls, structures, drive train, and threat protection. 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 maturation/validation include: aeromechanics; aerodynamics; structures; propulsion; reliability and maintainability; safety and survivability; mission support equipment integration; aircraft subsystems; advanced helicopter rotors and flight control, flight simulation; aircrew-aircraft system integration; aircraft weapons integration for air-to-air / air-to-ground; aircraft avionics integration and architecture for command and control; communications, controls and displays; digital avionics; nap-of-the-earth (NOE) navigation; mission planning; and air traffic management. These technologies are continuously being authenticated for applications that will improve and correct deficiencies in current Army / DoD RWV systems, and to improve the capabilities of future rotorcraft. The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, 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 maturation) and a coordinated government/industry/academia national RWV Technology Development Approach. This program adheres to DoD Reliance Agreements on Aeropropulsion and Air Vehicles (Rotary Wing). Technology demonstrated in this PE supports current and future rotorcraft for the Objective Force. Upgrade activities of Army systems such as the AH-64 Apache, RAH-66 Comanche, UH-60 Black Hawk, CH-47 Chinook, Navy SH-60 Seahawk and USMC AH-1 Cobra are supported as well. Related applied research is conducted under PE 0602211A (Aviation Technology). Efforts under this PE transition to programs supported by PE 0603801A (Aviation - Advanced Development), PE 0604801A (Aviation - Engineering Development) and PE 0604270A (Electronic Warfare Development). In addition, this PE's deliverables provide technical support and technology transition to RAH-66 Comanche, Longbow, and Aircraft Modifications/Product Improvements.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603003A - Aviation Advanced Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	33921	28810	41666	0
Appropriated Value	34167	28810	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-871	0	0	
c. Omnibus or Other Above Threshold Reductions	-133	0	0	
d. Below Threshold Reprogramming	-2311	0	0	
e. Rescissions	-113	-265	0	
Adjustments to Budget Years Since FY2001 PB	0	0	3177	
Current Budget Submit (FY 2002/2003 PB )	30739	28545	44843	0

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603003A - Aviation Advanced Technology</b>					PROJECT <b>313</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
313    ADV ROTARYWING VEH TECH	20870	14501	28102	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Advanced Rotary Wing Vehicle (RWV) Technology project matures and validates rotary wing platform technologies for the Objective Force. The Objective Force will require rotorcraft systems that have significantly increased/improved lift, range and survivability with an overall reduction in logistics. Key to this effort is to address the lift requirement of 10-20 tons for the Future Combat Systems. The critical technologies to support these capabilities will be matured through Technology Demonstrations (TDs) of rotors, active controls, structures, drive train, and threat protection. The Rotary Wing Structures Technology (RWST), Survivable, Affordable, Repairable Airframe Program (SARAP) and Full Spectrum Threat Protection (FSTP) TDs will increase the survivability and reduce weight, manufacturing and operational costs of the rotorcraft fuselages and wing subsystems. The Advanced Rotorcraft Transmission Phase II (ART-II) and Rotorcraft Drive Systems for the 21st Century (RDS21) TDs will provide a 25-35% reduction in weight and 15 decibel (dB) reduction in noise for advanced drive-systems. The Helicopter Active Control Technology (HACT) and Variable Geometry Advanced Rotor Demonstration (VGARD) TDs will contribute to a 50-100% increase in payload, 100-200% increase in range and 50-65% improvement in maneuverability / agility when integrated with the RWV system. These programs will focus on the maturation and transition of advanced technology for Objective Force rotorcraft. The funding profile supports these TD's that have been approved in Army modernization plans for rotorcraft. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 9544      - Conducted preliminary design of active flight control system.  
                  - Matured active flight control engineering models, and piloted and hardware in-the-loop simulation to support flight demonstration.  
                  - Determined reduction in flight control design and development costs.
- 6326      - Completed screening of candidate materials, structural concepts, manufacturing processes, and design tools for weight and cost reduction.  
  
                  - Completed risk mitigation testing and preliminary design efforts for technology demonstration articles (RAH-66 Comanche forward fuselage and AH-64 Apache center fuselage).  
                  - Determined high probability of meeting 15% weight reduction and 25% manufacturing labor reduction exit criteria.
- 5000      - Conducted component testing of ART-II positive engagement overrunning clutch.



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603003A - Aviation Advanced Technology**

PROJECT  
**313**

**FY 2000 Accomplishments (Continued)**

- Completed initial assembly of ART-II demonstrator hardware and conducted maturation tests 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.
- Completed 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 Black Hawk and AH-64 Apache helicopter transmissions.

Total 20870

**FY 2001 Planned Program**

- 8218 - Conduct detailed design of active flight control system. Integrate hardware and software into test rotorcraft.
  - Conduct flight control subsystems flight tests.
  - Refine helicopter active flight controls engineering models and simulation.
- 5519 - Prepare detailed design of test articles and fabrication of tooling and hardware.
  - Conduct full-scale static testing of rotary wing structural fuselage sections affirming weight, cost and development cycle time reductions.
- 375 - Conduct RDS21 preliminary design for 35% increase in power-to-weight, -15dB noise reduction, 2X increase in durability and 25% reduction in production cost.
- 389 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 14501

**FY 2002 Planned Program**

- 10491 - Down-select core concept technology mix for VGARD.
  - Prepare full-scale rotor preliminary design for VGARD.
  - Conduct rotor scaling and testing to evaluate technical risk.
  - Conduct small scale wind tunnel testing of rotor blade actuation concepts.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603003A - Aviation Advanced Technology**

PROJECT

**313**

## FY 2002 Planned Program (Continued)

- 6361 - Conduct RDS21 detailed design and analysis.
- 6300 - Perform helicopter active control system flight test. Analyze test results using metrics developed to quantify system improvements. Conduct HACT flight control system flight testing.
- 3251 - Identify and screen candidate technologies with potential to meet SARAP program goals of 25% weight and 40% manufacturing labor reductions compared to 1994 baseline.  
- Identify unique issues associated with large airframe affordability/survivability/reparability.
- 1699 - Conduct lab testing of candidate signature reduction hardware and active countermeasure devices for incorporation into the FSTP test platform. Design FSTP demonstrator.

Total 28102

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603003A - Aviation Advanced Technology**

PROJECT  
**435**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
435 AIRCRAFT WEAPONS	1078	3643	1794	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Aircraft Weapons project matures and affirms rotorcraft weaponization technologies for air-to-ground and air-to-air application. This project supports the Objective Force and Joint Vision 2020 by providing mature technology to focus combat power on multiple targets. The technology will provide precision engagement capabilities to meet the demands of Military Operations in Urban Terrain (MOUT), force protection, and other asymmetrical threats. Integration of advanced missiles (Air-to-Air / Air-to-Ground), rockets, guns, fire control, advanced target acquisition, and directed energy weapons, including non-lethal capabilities, are evaluated and tested 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-inch rocket with a laser seeker sensor and the project will evaluate other technologies for providing rotorcraft combat enhancements. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1078 - Conducted LCPK Advanced Technology Demonstration (ATD) AH-64D preliminary aircraft integration system analyses and design through a contract award to Boeing.
- Total 1078

**FY 2001 Planned Program**

- 3539 - Finalize LCPK ATD AH-64D aircraft integration system analyses and design. Build flight hardware for Apache Longbow to support airborne evaluation of the LCPK guided rocket. Investigate LCPK aircraft integration common areas with Army, Marine, and Special Operations Aviation (SOA) aircraft.
  - 104 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3643

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603003A - Aviation Advanced Technology**

PROJECT

**435**

## FY 2002 Planned Program

- 1794 - Conduct LCPK Advanced Technology Demonstration AH-64D aircraft integration and initiate airborne evaluation of the LCPK guided rocket.

Total 1794

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603003A - Aviation Advanced Technology</b>				PROJECT <b>436</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
436 ROTARYWING MEP INTEG	2034	3566	8120	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The Rotary Wing Mission Equipment Package Integration project matures and affirms man-machine integration and mission equipment technology to provide enhanced helicopter pilotage capability, to improve crew workload distribution and to improve overall mission execution. This project supports the Objective Force and Joint Vision 2020 by providing mature technology to enhance near-real time situational awareness for rotary wing vehicles. This project provides for the maturation of rotorcraft crew stations utilizing knowledge-based information systems to mature Cognitive Decision Aiding (CDA) for crews. Advanced integration technology in information management, sensors, displays, and controls will be matured to maximize combat helicopter mission effectiveness and survivability for day / night adverse weather operations. Virtual prototyping capability is used as the foundation for evaluating combined rotorcraft control and crew performance. The Airborne Manned/Unmanned System Technology (AMUST) program integrates advanced technologies in sensors, displays, communication and controls necessary to team airborne manned and unmanned vehicles to maximize the teams' lethality, survivability, and operational tempo in support of the maneuver commander. The manned/unmanned team will be capable of performing scout and reconnaissance assignments and alerting manned rotorcraft of "just ahead" tactical situation awareness. State-of-the-art approaches in artificial intelligence, intelligent agents, sensors, avionics, communications, pilot vehicle interfaces, and autonomous assistants will result in an integrated team that enhances Army aviation battlefield effectiveness. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2034 - Matured and affirmed Manned-Unmanned teaming with an AH-64D exercising payload and waypoint navigation control of a Hunter Unmanned Aerial Vehicle (UAV).
- Defined draft configuration and interface functional specs for manned (AH-64D and other manned systems) and unmanned (family of military UAVs) teams.

Total 2034

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603003A - Aviation Advanced Technology**

PROJECT

**436**

## FY 2001 Planned Program

- 3462 - Refine AMUST functional and interface specs to support critical operational functions.
    - Perform initial integration of CDA and AMUST technologies.
    - Conduct knowledge acquisition for scout / attack and Special Operations aviation forces' mission teams composed of manned and unmanned platoons.
    - Perform compatibility study with the Navy Tactical Control System (TCS).
  - 104 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3566

## FY 2002 Planned Program

- 8120 - Integrate AMUST technology with the Navy Tactical Control System (TCS).
    - Integrate AMUST technology with Warfighter's Decision Aid.
    - Expand AMUST teaming technology to other tactical UAVs.
    - Perform transition study of AMUST teaming technology to Comanche.
    - Flight test AMUST teaming technology with Warfighter's Decision Aid equipped Longbow Apache and other tactical UAVs as part of Hunter Standoff Killer Team (HSKT) Advanced Concept Technology Demonstration.
    - Develop interface control documents to integrate HSKT hardware in a System of Systems Construct, (i.e. Apache, Hunter Unmanned Aerial Vehicle (UAV), UH-60 with Army Airborne Command and Control System, and F/A 18).
    - Develop, with user, tactics, techniques, and procedures for HSKT.
    - Develop, with user, training concepts for HSKT System of Systems.
- Total 8120

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603003A - Aviation Advanced Technology**

PROJECT  
**447**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
447 ACFT DEMO ENGINES	6757	6835	6827	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This Aircraft Demonstration Engines project matures power system technology through competitively performed design, fabrication and test of advanced technology, engines and integrated components to affirm achievable improved performance levels for current and future DoD rotary wing vehicles emphasizing Army unique requirements. This project supports the Objective Force and Joint Vision 2020 by providing mature technology to improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. 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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 6757 - Demonstrated, via testing of the initial build which includes a splattered rotor (rotor with a set of full blades and a set of half blades to improve efficiency), Rich-Quench-Lean (RQL) Lycolite combustor, high work turbine, and hybrid ceramic bearings, progress towards meeting JTAGG II goals of 80% increase in shaft horsepower to weight ratio, 30% decrease in SFC and 20% reduction in production and maintenance costs.
- Completed detail design of engine components for initial gas generator build of JTAGG III program.

Total 6757

**FY 2001 Planned Program**

- 6636 - Affirm in testing of the final core engine build, which introduces the High Effectiveness Affordable Turbine (HEAT) blades into the turbine for full life (6000 hours), the JTAGG II goals of 80% increase in shaft horsepower to weight ratio, 30% decrease in SFC and 20% reduction in production and maintenance costs.
- Fabricate initial JTAGG III gas generator hardware and complete initial JTAGG III build component testing.
- 199 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 6835

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603003A - Aviation Advanced Technology**

PROJECT  
**447**

## FY 2002 Planned Program

- 6827 - Conduct testing of JTAGG III initial gas generator build, which includes a forward swept splintered rotor, a split-inducer impeller, a ceramic matrix composite combustor liner and uncooled ceramic low pressure turbine blades.
- Conduct testing of JTAGG III second gas generator build which introduces a ceramic matrix composite turbine nozzle and cooled ceramic turbine blades in the high pressure turbine.

Total 6827



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603004A - Weapons and Munitions Advanced Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	54526	55227	29684	0	0	0	0	0	0	0
232 ADVANCED MUNITIONS DEM	15723	18537	29684	0	0	0	0	0	0	0
244 WARHEAD AND ENERGETICS CENTER OF EXCELLENCE	4773	0	0	0	0	0	0	0	0	0
43A ADV WEAPONRY TECH DEMO	34030	36690	0	0	0	0	0	0	0	0
L94 ELECTRIC GUN SYS DEMO	0	0	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) demonstrates affordable, smaller and/or lighter advanced weapons and munitions technologies to increase battlefield lethality and survivability for the Future Combat Systems (FCS) and the Objective Force. Specific efforts include: FCS Multi-Role Armament and Ammunition; Direct Fire Lethality (DFL) Program; Tank Extended Range Munition (TERM); Precision Guided Mortar Munition (PGMM); and Responsive Accurate Mission Module (RAMM). The FCS Multi-Role Armament utilizes electrothermal-chemical (ETC) propulsion and provides a single armament module configuration supporting both maneuver and fire support missions. The corresponding FCS Multi-Role Ammunition, a three-cartridge suite, provides overwhelming lethality at ranges up to 50 kilometers with greater precision and accuracy and reduced logistics footprint for the Objective Force. In the area of combat vehicle anti-armor munitions, advanced explosively formed penetrator (EFP) warheads exploit technologies in explosives, liner materials and modeling, and demonstrate increased armor penetration through advanced warhead concepts. 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). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603004A - Weapons and Munitions Advanced Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	58042	29738	12201	0
Appropriated Value	58643	55738	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR/STTR	-1355	0	0	
c. Omnibus or Other Above Threshold Reductions	-208	0	0	
d. Below Threshold Reprogramming	-2161	0	0	
e. Rescissions	-393	-511	0	
Adjustments to Budget Years Since FY2001 PB	0	0	17483	
Current Budget Submit (FY 2002/2003 PB )	54526	55227	29684	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for Multi-role FCS Armaments (+10000), Precision Guided Mortar Munition (+6000), Viking Indirect Fire Module (+5000) and SMAW-D Concept Demo Testing (+5000).

FY 2002/2003 (+12483) funding was increased for Multi-role FCS Armament in support of Army transformation and (+5000) to support time critical, standoff, and concealed target defeat (Project 232).

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603004A - Weapons and Munitions Advanced Technology</b>					PROJECT <b>232</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
232      ADVANCED MUNITIONS DEM	15723	18537	29684	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project demonstrates munition enhancements for the Objective Force and the FCS Multi-Role Armament and Ammunition, as well as emerging technologies in lightweight structures, smart materials and in-flight update architectures. This project includes the DFL program which will enhance kinetic energy (KE) penetrator lethality against explosive reactive armor (ERA) appliqué arrays now available on fielded threat systems, through use of a novel penetrator defeat mechanism. TERM will evaluate warhead designs versus range targets. RAMM lightweight mortar concept suitable for insertion into a generic FCS platform will be developed. A Congressionally funded effort to perform feasibility studies adapting the Shoulder-Launched Multipurpose Assault Weapon-Confined Space (SMAW-CS) to the Bunker Defeat Munition will be completed. In-house efforts are accomplished by Armament Research Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey and the Army Research Laboratory, Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp., McLean, VA; LTV Aerospace, Dallas, TX; Textron Defense Systems, Wilmington, MA; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; PRIMEX-Flinchbaugh, Red Lion, PA; Alliant Tech Systems-Allegheny Ballistics Laboratory, Rocket City MD and Raytheon/TI Systems, Tucson, AZ. This program supports the Objective transition path of the Transformation Force Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 6315 Completed extended range novel KE penetrator flight functional tests; completed integrated cartridge design for FY 2001 Advanced Technology Demonstration (ATD) of 50%+ increase in armor penetration over 120mm M829A2.
- 7488 Completed development of TERM multi-sensor technologies that have applicability to smaller, lighter armaments for the FCS; conducted captive flight test (CFT) verification of sensor technology.
- 1920 Completed one-year Congressionally directed program, which conducted multi-role cannon armament system turret design studies for FCS; successfully demonstrated potential of 70% reduction in cannon recoil forces.

Total 15723

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603004A - Weapons and Munitions Advanced  
Technology**

PROJECT

**232**

## FY 2001 Planned Program

- 6500 Demonstrate advanced KE munition novel penetrator defeat against ERA with an increase in penetration of at least 50% over the M829A2 at extended range; demonstrate feasibility of minimum 30% increase in system accuracy (probability of hit) with radial thruster technology on KE penetrators.
- 6705 Complete TERM warhead design and analysis; conduct warhead testing versus range targets; perform ballistic test firings of the TERM propulsion system over the temperature ranges; update tactical seeker design; transfer design and technology to Multi Purpose-Extended Range Munition for FCS.
- 4807 The purpose of this one year Congressional add is to conduct a feasibility study adapting SMAW-CS to Bunker Defeat Munition; conduct modeling and simulation and limited test and evaluation of prototype hardware.
- 525 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 18537

## FY 2002 Planned Program

- 5924 Conduct airframe and lethality demonstrations for Multi-Purpose Extended Range Munition (MP-ERM).
- 1760 Complete design and initiate fabrication of medium caliber air bursting projectile; conduct medium caliber novel kinetic energy penetrator testing against advanced armors.
- 17000 Complete the following for the FCS Multi-Role Armament: Fabricate and conduct functional test of lightweight, low impulse multi-role cannon for FCS; fabrication of automated ammunition handling system and load/unload function testing with multi-role cannon; demonstrate Best Technical Approaches for electrothermal-chemical (ETC) propellant with increased energy and lower sensitivity; complete fire control software development, hardware integration, and conduct preliminary System Integration Laboratory Prove-out.
- 5000 Complete Multi-Role Smart Cargo projectile design to include guidance and control; demonstrate best technical approaches for dynamic retargeting to locate and defeat time critical targets; demonstrate by modeling and simulation, maximized payload volume using smart materials, structures and metal matrix composites for airframe.

Total 29684

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603004A - Weapons and Munitions Advanced Technology</b>					PROJECT <b>43A</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
43A ADV WEAPONRY TECH DEMO	34030	36690	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project demonstrates system and lethality enhancements to support the Objective Force and the FCS Multi-Role Armament and Ammunition. Included are Captive Flight Tests (CFT) to validate TERM sensor concepts; high-G and live fire testing of the PGMM; completion of Electro-Rheological fluid characterization; conduct integration testing of advanced penetrators with composite sabots to support the FCS ammunition; and completion of Congressionally funded program to evaluate 120mm mortar, one-tenth training round. This project will demonstrate a single compact armament mission module configuration for the FCS Multi-Role Armament, an ETC system suitable for a lightweight combat vehicle to support maneuver and fire support missions. It will explore automation, recoil mitigation and weight reduction technologies to achieve maximum mission flexibility. Efforts on the corresponding FCS Multi-role Ammunition will develop next generation ETC propellant and MP-ERM. 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, Lowell, MA; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; PRIMEX-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; Design Systems Technologies Inc. (DSTI), Rockville, MD, Alliant Tech Systems, Allegheny Ballistics Laboratory, Rocket City MD, Raytheon/TI Systems, Tucson, AZ. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 9694 Conducted sensor demonstrations of TERM concepts using simulation and CFT to validate sensor footprint and acquisition capabilities to support extended range precision engagements out to 8 kilometers; defined TERM fire control system and munition concept design; transfer design and technology to MP-ERM for FCS.
- 6163 Conducted PGMM system high-G tests via parachute round firings; conducted wind tunnel tests; conducted flight integrity live fire tests; completed gyroscope integration; conducted simulation and modeling effort for area denial.
- 4791 Completed one year Congressionally directed program which isolated the root cause of PGMM sluggish fin opening times and designed/tested new fin assembly (Root cause successfully identified and new fin design successfully functioning in live fire tests.); Performed constructive simulations using Training and Doctrine Command (TRADOC) Analysis Center (TRAC) certified vignette experiments; isolated gyro drift error sources; redesigned and validated fixes to gyro subsystem via railgun testing; completed laser seeker design and began component testing.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603004A - Weapons and Munitions Advanced  
Technology**

PROJECT  
**43A**

## FY 2000 Accomplishments (Continued)

- 4866 Completed fabrication of the future direct support weapon system demonstrator, and initiated requirements analyses to determine suitability of related technologies for incorporation into the FCS Multi-Role Armament.
- 4791 Completed one year Congressionally directed program which completed electro-rheological (ER) fluid research including fluid characterization, software control methodology, materials and structures modeling, and power supply design.
- 2042 Conducted integrated demonstrations of novel dual penetrator systems to establish enhanced defeat of complex armor with less than five megajoules of energy on target.
- 725 Completed one year Congressionally directed program to select and test two candidate approaches for low cost microchip lasers suitable for laser rangefinders.
- 958 Completed one year Congressionally directed program, which procured and evaluated prototype quantities of 120mm, one-tenth range training rounds to verify performance and reusability.

Total 34030

## FY 2001 Planned Program

- 2000 Complete CFT of TERM sensor technologies; conduct subsystem technology demonstrations of TERM concepts including warhead, propulsion and high-G testing; update system designs and complete design transfer to MP-ERM for FCS.
- 1447 Complete demonstrations of candidate medium caliber non-depleted uranium (DU) novel kinetic energy penetrator for evaluation of increased behind armor effects; complete design of medium caliber air bursting warheads for application to FCS.
- 4899 Conduct flight integrity live fire tests, hardware in-the-loop simulations and perform PGMM Advanced Technology Demonstration (ATD) laser round demonstration firings; build and test area denial hardware and conduct system demonstration.
- 5819 This one year Congressional add for PGMM supports these efforts: perform live fire test of prototype, 3-axis gyro subsystem; perform wing deployment test of system high-G rounds; perform live fire test of prototype seeker subsystem.
- 14551 The purpose of this one year Congressional add is to complete the following in support of the FCS Multi-Role Armament and Ammunition; Design and initiate fabrication of lightweight cannon for Multi-Role Armament; fabricate test hardware and validate, via firings, multi-role cannon chamber and ammunition cartridge case functionality; complete design of automated ammunition handling system; initiate turret design studies for best technical approach for single armament module for maneuver and fire support applications.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603004A - Weapons and Munitions Advanced  
Technology**

PROJECT

**43A**

## FY 2001 Planned Program (Continued)

- 4902 Complete the following in support of the FCS Multi-Role Armament: Complete development of candidate Generation II ETC propellant formulations for 25% increased energy (performance) with equal sensitivity to current tank ammunition; initiate design concept study of MP-ERM with precision defeat capability out to 10 kilometers against high value point targets.
- 2000 Conduct integration testing of advanced penetrator designs and composite sabots.
- 1072 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 36690

## FY 2002 Planned Program

Project not funded in FY 2002.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive Advanced Tech**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	197092	166571	193858	0	0	0	0	0	0	0
221 COMBAT VEH SURVIVABLT	19915	28063	32160	0	0	0	0	0	0	0
440 ADV CBT VEHICLE TECH	127692	84933	15745	0	0	0	0	0	0	0
441 COMBAT VEHICLE MOBILTY	7931	7410	14732	0	0	0	0	0	0	0
497 COMBAT VEHICLE ELECTRO	5625	2969	5616	0	0	0	0	0	0	0
502 HAECO II	5727	0	0	0	0	0	0	0	0	0
506 METAL MATRIX COMPOSITES	6682	7927	0	0	0	0	0	0	0	0
515 ROBOTIC GROUND SYSTEMS	0	1746	9300	0	0	0	0	0	0	0
532 ABRAMS ENGINE	4773	0	0	0	0	0	0	0	0	0
533 TECHNOLOGY TRANSFER CENTER	7636	4954	0	0	0	0	0	0	0	0
539 MOBILE PARTS HOSPITAL	2864	7927	0	0	0	0	0	0	0	0
53B FUEL CELL AUX POWER UNITS FOR LINE HAUL TRUCKS	0	2972	0	0	0	0	0	0	0	0
53C NATIONAL AUTOMOTIVE CENTER - UNIV INNOVATIVE RSCH	0	2972	0	0	0	0	0	0	0	0
53D NATIONAL AUTOMOTIVE CNTR & WARFIGHTING BATTLE LABS	0	3963	0	0	0	0	0	0	0	0
53E IMPACT TRUCK PROGRAM	0	4954	0	0	0	0	0	0	0	0
53F NAC STANDARD EXCHANGE OF PRODUCT MODEL DATA	0	2972	0	0	0	0	0	0	0	0
53G FUTURE COMBAT SYSTEMS (FCS)	0	0	111560	0	0	0	0	0	0	0
540 IMPROVED HMMWV RESEARCH	5727	0	0	0	0	0	0	0	0	0
C66 DC66	2520	2809	4745	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007**



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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive Advanced Tech**

requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

The goal of this Program Element (PE) is to mature and demonstrate new and improved combat vehicle and automotive technologies to enable transformation of the Army to the Objective Force. Future Combat Systems (FCS), the Army's top priority S&T program, is the primary emphasis of work funded in this PE to support Army Transformation. A large portion of the funds in this PE support the collaborative Army/Defense Advanced Research Projects Agency (DARPA) FCS program and providing support for the FCS analysis function of the Objective Force Task Force. Starting in FY 2002, these funds have been placed in a new project, 53G, in this PE. A Memorandum of Agreement signed by the Army and DARPA in February 2000 delineates the approach, funding and responsibilities. The Army vision calls for strategic dominance across the spectrum of operations. This spectrum of likely operations demands a force that is deployable, agile, versatile, lethal, survivable and sustainable. In addition to system demonstrations, like FCS, this PE supports the following enabling component technology areas: survivability (e.g., Full Spectrum Active Protection (FSAP)), mobility (including a new engine demonstration initiative with a goal to double the power density of a comparable commercial engine to meet FCS power, size, and weight constraints), and intra-vehicular digital electronics. It also integrates diverse vehicle technologies developed by the Army, other DoD agencies and industry. These technologies are demonstrated in coordination with Army warfighter organizations through vehicle component and system level technology demonstrations. In addition to FCS, system level demonstrations also include the Future Scout and Cavalry System (FSCS) Advanced Technology Demonstration (ATD), a cooperative US/United Kingdom program. FSCS ATD will be completed in July FY02 with a robust demonstrator provided by each contractor team to assess the warfighting capabilities of the advanced technology incorporated into the FCS design. The FSCS ATD program is viewed by the US Army as a technology carrier for FCS and, possibly, for the Interim Brigade Combat Team. In coordination with the UK, the Army will extend the FSCS program from its planned completion in July 2002 to April 2003 to further test and demonstrate FSCS technologies that may transition to FCS. This PE is managed by the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC), a subordinate organization of the Tank-Automotive and Armaments Command (TACOM), located in Warren, MI. This 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). Furthermore, the project is coordinated with the Marine Corps office through the Naval Surface Warfare Center; the Naval Research Lab; Air Force Armaments Command; and with other ground vehicle developers within the Departments of Energy, Commerce, Transportation, and DARPA. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by TACOM-TARDEC. New projects have been established for Congressional special interest programs not associated with existing programs within this PE. These new projects include the following topics: Metal Matrix Composites, Technology Transfer Center, Mobile Parts Hospital, Fuel Cell Auxiliary Power Units for Line Haul Trucks, National Automotive Center (NAC) - University Innovative Research, NAC and Warfighting Battle Labs, Improved Materials and Powertrain Architecture for 21st Century Trucks (IMPACT), and NAC Standard Exchange of Product Model Data. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive Advanced Tech**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	130525	148114	117403	0
Appropriated Value	131941	168114	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-3322	0	0	
c. Omnibus or Other Above Threshold Reductions	-511	0	0	
d. Above Threshold Reprogramming	65894		0	
e. Below Threshold Reprogramming	3995	0	0	
f. Rescissions	-905	-1543	0	
Adjustments to Budget Years Since FY2001 PB	0	0	76455	
Current Budget Submit (FY 2002/2003 PB )	197092	166571	193858	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were provided for FCS (+46000)( project 440), Composite Armored Vehicle (+4000) (project 440), Silicon Carbide Research (+8000) (project 506), Combat Vehicle and Automotive Technology Weight Reduction (+5000) (project 533), Mobile Parts Hospital Technology (MPHT) Program (+8000) (project 539), Fuel Cell Auxiliary Power Units (+3000) (project 53B), National Automotive Center (NAC) University Innovative Research (+3000) (project 53C), Warfighting Battle Labs (+4000) (project 53D), Improved Materials & Powertrain Architecture for 21st Century Trucks-IMPACT (+5000) (project 53E), and Advanced Combat Vehicle Technology Program (+3000) (project 53F).

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)****June 2001**

## BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

## PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive Advanced Tech**

The Future Scout & Cavalry Systems (FSCS) ATD was zeroed (-69000)( project 440), but the Congress approved Army reprogramming of FY 2000 funds for the ATD.

(+46000) (project 440) This one-year Congressional add was provided to reduce risk and accelerate the FCS program.

These funds were allocated as follows to support the Army/DARPA collaborative FCS program and key enabling technologies: FCS contractor augmentations (16000), Joint Virtual Battlespace modeling and simulation effort (15800), additional DARPA Netfires contractor (6700), Turbo Fuel Cell Engine (3300), Full Spectrum Active Protection (2000), and Command, Control, Communications and Computers/Intelligence, Surveillance and Reconnaissance Study and Assessment (1000). 1200 was rescinded by Congress.

- (+8000) (project 506) This continues several Congressional adds to develop, test and qualify metal matrix track shoes. No additional funding is required to complete this project.

- (+5000) (project 533) This one year Congressional add develops an extensive ballistic data base on aerospace aluminum-lithium alloys and demonstrates scale-up of Friction Stir Welding technology on a full size, full engineering and manufacturing detail advanced aluminum combat vehicle hull and turret structures for improved ballistic performance and manufacturing producibility.

- (+8000) (project 539) This is the second Congressional add to demonstrate a mobile manufacturing capability to produce automotive parts. No additional funding is required to complete this project.

- (+3000) (project 53B) This one-year Congressional add will evaluate reformer based, diesel fueled fuel cell auxiliary power units (APUs) for military and commercial utilization. No additional funding is required to complete this project.

- (+3000) (project 53C) This one-year Congressional add will develop automotive analysis tools. No additional funding is required to complete this project.

- (+4000) (project 53D) This one-year Congressional add will develop a synthetic collaborative environment to conduct real-time User/Developer design analyses. No additional funding is required to complete this project.

- (+5000) (project 53E) This one-year Congressional add will develop and validate technologies for next generation trucks. No additional funding is required to complete this project.

- (+3000) (project 53F) This one-year Congressional add will supplement 0603005A, project 440 task by fabricating large structural test sections and components for integration into an Integrated Hybrid Structure. No additional funding is required to complete this project.

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)****June 2001**

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive Advanced Tech**

FY 2002 - Funds were added: for unmanned ground vehicles (5000) to increase their autonomy (Project 515); for competitive demonstration of high power density engines for FCS (Project 441) (10000); to demonstrate active protection while moving (Project 221) (3000); and to further mature FSCS technology to reduce risk for FCS (Project 440) (5000).

Funding increases in FY 2002/2003:

FY 2002 (+29500) and FY2003 (+65000) in project 53G to fully fund Army share of collaborative Army/DARPA FCS program in accordance with the MOA. FY 2002 (+3447) and FY 2003 (+7109) in project 221 funds added to demonstrate full spectrum active protection on the move (versus stationary only). FY 2002 (+20478) and FY 2003 (+38946) in project 53G to increase competition and reduce risk by maintaining second FCS contractor team, and to provide operating resources for the Objective Force Task Force. A one-year NetFires effort is funded in PE 0603313A at 10000; the remaining Army funds for NetFires are in PE 0603005A.

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603005A - Combat Vehicle and Automotive Advanced Tech</b>					PROJECT <b>221</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
221 COMBAT VEH SURVIVABLTY	19915	28063	32160	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project demonstrates the advanced vehicle protection technologies needed for a force that is survivable across the full spectrum of operations. As combat systems become smaller and lighter to provide the necessary strategic and tactical mobility, providing adequate protection without reliance on heavy armor is one of the greatest technological and operational challenges. The solution involves developing and integrating an optimal suite of protection approaches such as armor, active protection systems (APS), signature reduction, jammers, and decoys. Advanced component technologies for APS that provide protection against threat munitions (e.g., guided and unguided anti-armor munitions) will be integrated, demonstrated and provided to Future Combat Systems (FCS) contractors for incorporation into their designs. Initial APS efforts have been focused on demonstrating the technologies needed for a system that is effective against Chemical Energy (CE) munitions (e.g., anti-tank guided missiles with shaped charge warheads). The ultimate goal is a Full Spectrum Active Protection (FSAP) system which will provide hemispherical survivability against CE threats, plus large caliber tube launched Kinetic Energy and top attack threats. Survivability technologies that are integrated and demonstrated in the laboratory and the field under this project include those technologies transitioned from the following program elements: 0601102A, 0602270A. Major contractors include: United Defense Limited Partnership, San Jose, CA; Sanders, a Lockheed Martin Company, Nashua, NH; TRW, Redondo Beach, CA; Hughes Danbury, Danbury, CN; General Dynamics Land Systems, Warren, MI; Chang Industries, Salt Lake City, UT & Laverne, CA; New Mexico Tech, Socorro, NM; IST, Goleta, CA, Aerojet, Azusa, CA. This program supports the Objective Force transition path of the Transformation Campaign Plan TCP.

**FY 2000 Accomplishments**

- 1547 - Provided program management for APS technology maturation, advanced survivability technologies integration, and other government agency/user/test support.
- 17873 - Completed detailed survivability system design.
  - Performed APS development and subsystem testing under contract with United Defense Limited Partnership (UDLP).
  - Conducted integration of all sensors and countermeasures; tested system in Systems Integration Laboratory (SIL).
  - Demonstrated physical system integration on vehicle test bed mockup; integrated software into vehicle electronic architecture and verified functionality/safety; exercised overall system in SIL.
- 495 - Purchased threat munitions and test assets for integration testing.

Total 19915

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive  
 Advanced Tech**

PROJECT  
**221**

**FY 2001 Planned Program**

- 1462 - Provide program management for APS technology maturation and advanced survivability technologies integration and other government agency/user/test support.
- 15147 - Conduct APS development and testing of advanced technologies under contract with UDLP; complete APS component integration.  
 - Conduct vehicle system integration and complete final checkout.  
 - Conduct system and subsystem performance testing; verify functional integration, sensor fusion, and countermeasure performance.
- 818 - Mature APS radar design and investigate advanced tracking radar technologies for FCS.
- 193 - Procure test munitions for system testing.
- 4825 - Design and fabricate extended range sensor capability to detect and track KE threats for FSAP system.  
 - Design and fabricate KE defeat countermeasure warheads compatible with a rocket delivery system.  
 - Prepare a Coordinated Test Plan.
- 4825 - Evaluate emerging signature management technologies utilizing survivability optimization modeling to reduce combat vehicle detection probabilities.  
 - Conduct an initial test evaluation of emerging signature management technologies to quantify performance.
- 793 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 28063

**FY 2002 Planned Program**

- 12352 - Conduct testing to demonstrate defeat of Anti-Tank Guided Missiles, Rocket Propelled Grenades and smart munitions with the survivability system integrated on a surrogate platform.  
 - Provide APS hardware, software and design for use in development of a FSAP suite applicable to FCS.  
 - Develop final report and video summarizing all testing and accomplishments of the program; develop design guides for vehicle PM use.
- 388 - Perform distributed interactive simulation for combat fidelity testing and user evaluation.
- 1564 - Provide program management for APS development and advanced survivability technologies integration and other government agency/user/test support.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT

**221**

## FY 2002 Planned Program (Continued)

- 897 - Conduct field testing to evaluate performance of integrated survivability system.
- 5512 - Test and demonstrate tracking radar sensor technology for FSAP KE detection and tracking.
  - Conduct range tests of FSAP KE countermeasure warheads against multiple horizontal and overhead threats.
  - Locate and obtain threats for coordinated test and evaluations.
  - Integrate countermeasure and sensor subsystem models for FSAP performance simulations.
- 5000 - Conduct full scale breadboard testing to quantify field performance and validate signature modeling predictions.
  - Develop virtual models of vehicle integration concepts to predict signature management performance.
  - Mature advanced signature management to prepare for FY 2004-2005 full scale performance testing.
- 6447 - Design and develop control algorithms and platform stabilization hardware for APS on-the-move demonstration.
  - Initiate hardware build of stabilization units.
  - Conduct preliminary testing of stabilization hardware configuration.

Total 32160

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603005A - Combat Vehicle and Automotive Advanced Tech</b>				PROJECT <b>440</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
440 ADV CBT VEHICLE TECH	127692	84933	15745	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project demonstrates the operational potential, technical feasibility and maturity of advanced combat vehicle technologies through integrated demonstrations (e.g., subsystems, systems, and system of systems). Two major initiatives are funded by this project, the FSCS ATD and the initial funding for the collaborative Army/DARPA FCS program as described in the Memorandum of Agreement (MOA) signed February 2000. Starting in FY 2002 Army funds for the Army/DARPA FCS effort have been transferred from this project to project 53G to give them better visibility. Funds for FCS are also contained in PE 0602601, Project HH7, for FY 2001-2002. See project 53G for a description of the FCS program. The objectives of work performed under this project are to demonstrate innovative concepts and combat vehicle configurations, enabling technologies and integration techniques, yielding hardware technology demonstrations, computer simulations and full-scale demonstrations to accomplish a more rapid and seamless transition of advanced technologies into systems applications. All demonstrations include user and developer teaming in field and/or laboratory environments. The FSCS ATD integrates advanced technologies, including sensors, survivability, mobility technologies and communications into a robust vehicle platform. Two consortia, SIKA and Lancer, are operating under firm fixed price contracts awarded by the United Kingdom. Congress zeroed the Army's FY 2001 request for the FSCS ATD without prejudice. In September 2000, the Congress approved reprogramming of FY 2000 funds in the amount of \$65.894M for the FSCS Program. Technologies and lessons learned about integration of FSCS technologies on a C-130 transportable platform are important to reduce risk and accelerate development and fielding of the FCS. FSCS ATD will be completed in July FY02 with a robust demonstrator provided by each contractor team to assess the warfighting capabilities of the advanced technology incorporated into the FCS design. The FSCS ATD program is viewed by the US Army as a technology carrier for FCS and, possibly, for the Interim Brigade Combat Team. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

- 18719 - Evaluated the affordability of hardware and software alternatives and system concepts for FSCS.
  - Completed sub-system and system trade studies to define cost effective hardware configurations for FSCS.
  - Developed simulations and virtual prototypes for FSCS.
  - Conducted UK Ministry of Defense/US Department of Defense System Design Reviews
- 26272 - Procured hardware and fabricated sub-system assemblies for FSCS.
  - Assembled System Integration Laboratories (SILs) for FSCS.



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive  
 Advanced Tech**

PROJECT  
**440**

**FY 2000 Accomplishments (Continued)**

- Performed sub-system testing and evaluation for FSCS.
- Conducted analysis of survivability design alternatives for FSCS.
- 5699 - Performed Cost as an Independent Variable (CAIV) analysis and trade studies for FSCS.
- Completed analysis to support refinement of Combined Operational Requirements Document for FSCS.
- Completed Cooperative Analysis of Alternatives (CAA) to support 3-Star affordability review of FSCS.
- Continued support and participation in Government/contractor IPTs.
- 2898 - Continued modeling and simulation concepts in support of FSCS ATD contractor efforts.
- Investigated application of Joint Tactical Radio System (JTRS) to FSCS.
- 22894 - Perform FSCS trade studies and cost effective alternatives for FSCS for completion in FY 2001.
- Provide affordability data for US/UK 3-Star affordability review of FSCS in FY 2001.
- Incorporate simulation and virtual prototyping results into FSCS development process for completion in FY 2001.
- Perform subsystem and SIL fabrication for FSCS for completion in FY 2001.
- 43000 - Perform fabrication and integration of FSCS demonstrator vehicles for completion in FY 2001.
- Perform fabrication and evaluation of survivability designs for FSCS for completion in FY 2001.
- Perform subsystem test and evaluation for FSCS for completion in FY 2001.
- Perform system shakedown test and evaluation efforts for FSCS for completion in FY 2001.
- 5312 - Initiated collaborative Army/DARPA FCS program containing two major efforts per the MOA , (1) core FCS design/build/demonstration, (2) joint Army/DARPA enabling technologies. Awarded four Section 845 Agreements for the core FCS effort to teams: Full Spectrum, Focus Vision, Gladiator and Boeing to develop system concepts, modeling and simulation, and support government experiments to develop concepts of operations (CONOPS).
  
- Initiated Army/DARPA FCS Enabling Technologies efforts in Robotic Unmanned Ground Vehicle, Maneuver Command and Control Communications, Maneuver Beyond-line-of-sight (BLOS) Networked Fires Weapon and BLOS Surveillance and Targeting System per MOA; awarded contract for the development of NETFIRES loitering attack and precision attack munitions; initiated a program in autonomous UAV development for perching sensors and communication relays in all weather; initiated a program to look through the canopy LADAR image reconstruction and target recognition technology development.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive  
 Advanced Tech**

PROJECT  
**440**

**FY 2000 Accomplishments (Continued)**

- 2898 - Completed Congressional add, integrated Composite Armored Vehicle technology with aerospace metals into non-traditional structural approaches for a light weight "tracks-over-wheels" chassis.

Total 127692

**FY 2001 Planned Program**

- 7197 - Provide Army's share of funds in support of Army/DARPA FCS concept development for four contractor teams (7752 in PE 0602601A, Project HH7, also supports this effort).
  - Continue develop metrics for evaluation of Objective Force performance; design and demonstrate force-level simulation capability for Objective Force.
  - Conduct technical and operational experimentation in support of system design concepts; demonstrate use of and complete architecture for Integrated Data Environment (IDE).
  - Conduct technology and operation trade-assessments to determine optimum design for each systems concept.
- 28272 - Provide Army's share of funds in support of Army/DARPA FCS enabling technologies as follows:
  - Netfires: produce system prototypes.
  - Autonomous Navigation (Preceptor): Award Section 845 agreement; produce robotic surrogates for testing in FY 2002.
  - Unmanned Ground Vehicle Program: Award ten (10) Section 845 agreements to investigate/study concepts for unmanned ground vehicles.
  - Laser Radar (LADAR) Through Canopy (Jigsaw): Award Section 845 agreement to develop technical approaches for producing a LADAR that can see through canopies.
- 3963 - Complete Congressional special interest program to demonstrate hybrid structure/armor concepts for achieving chassis weight reductions while sustaining high protection levels.
- 45501 - Reduce technical and schedule risk for FCS program by increasing the competition for ideas by the Army/DARPA FCS contractors, increase funds for critical Army enabling technologies, and bolster modeling and simulation to support the Army/DARPA FCS program as follows:
  - Augment Army/DARPA FCS contractor teams.
  - Perform government modeling and simulation to support FCS program.
  - Demonstrate additional, competing Netfires concept.
  - Complete Congressional special interest program to demonstrate turbo fuel cell engine

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

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PROJECT  
**440**

## FY 2001 Planned Program (Continued)

- Conduct government C4ISR architecture study and analysis.

Total 84933

## FY 2002 Planned Program

- 10745 - Conduct combined US/UK user test of FSCS ATD demonstrator vehicles.  
- Conduct combined US/UK evaluation and analysis of FSCS ATD demonstrator vehicles and prepare final report.
- 5000 - Continue testing FSCS components and demonstrators.

Total 15745

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT  
**441**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
441 COMBAT VEHICLE MOBILTY	7931	7410	14732	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures and tests vehicle mobility technologies that that will provide lighter, agile, deployable, and more fuel efficient ground combat vehicles needed for FCS and the Army Transformation to the Objective Force. The principal elements of these mobility demonstrations are: active and semi-active suspensions, hybrid-electric drive, and lightweight track. Because commercial engines lack the necessary power density for the power, space and weight constraints of FCS, and fuel cells are not expected to be sufficiently mature for FCS fielding, the Army will demonstrate high power density engines starting in FY02. This competitive program will seek to double the power density (horsepower per cubic foot) of a comperable, state-of-the-art, commercial engine. Military requirements for vehicle mobility are unique because of: (1) the need for a stable ride at high speeds (above 20 miles per hour) over cross country terrain for weapon targeting on the move, crew comfort and endurance and accomplish the maneuver-dominant warfare, (2) the need for compact and light vehicle systems to reduce vulnerability of detection, acquisition and attack by enemy weapons, enhanced deployability and reduced logistics burden (e.g., fuel), (3) the need to protect vehicle subsystems under armor (e.g., complicates design of air intake and exhaust systems). Hybrid-Electric drive offers unique capabilities, such as improved performance, silent operation and vehicle design flexibility; however, it presents new challenges, especially in power electronics thermal management. Army efforts in hybrid electric drive have leveraged two joint Army/DARPA programs, Combat Hybrid Power System (CHPS) and the Electric Drive Vehicle Demonstration Program. CHPS successfully transitioned to the Army in FY 2000 with the objective of designing, maturing and testing a robust ground vehicle electrical power architecture in a systems integration laboratory that will support the FCS program. Government partners include: Army Research Laboratory (ARL), Aberdeen Proving Ground, MD; Waterways Experiment Station, Vicksburg, MS; Army Research Laboratory, Adelphi, MD. Major contractors include: General Dynamics Land Systems Muskegon Operations, Muskegon, MI; Pentastar, Huntsville, AL; SAIC, San Diego, CA; United Defense Limited Partnership, San Jose, CA; Michigan Technological University, Houghton, MI; General Electric, Schenectady, NY; and Cadillac Gage Textron, New Orleans, LA. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

- 3292 - Configured and installed an optimized preview sensor on High Mobility Multipurpose Wheeled Vehicle (HMMWV) for active suspension; installed compressible fluid suspension on HMMWV for improved cross-country mobility.
- Evaluated and selected electric drive components of CHPS for installation on a mobility testbed.
- Fabricated and began testing of lightweight band track, for 25 ton vehicle, which will reduce weight, lower cost and provide for quieter combat vehicles.
- Performed shakedown and laboratory performance testing of a compact, high efficiency mechanical transmission.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

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**0603005A - Combat Vehicle and Automotive  
 Advanced Tech**

PROJECT  
**441**

**FY 2000 Accomplishments (Continued)**

- 2689 - Transferred the CHPS SIL and Virtual Prototype from DARPA to U.S. Army TARDEC.  
 - Updated the DARPA CHPS Virtual Prototype models based upon information obtained from SIL assessments.  
 - Completed the DARPA CHPS program by demonstrating the feasibility of a hybrid architecture in the completed SIL .
- 1950 - Began integration of advanced components (e.g., high power/high energy pulse forming network, flywheel, high temperature/fast response converters and advanced high energy density batteries) for assessment in the CHPS SIL.

Total 7931

**FY 2001 Planned Program**

- 2706 - Install, test, and refine low bandwidth, compressible fluid, active suspension to enable increased combat vehicle mobility and speed over cross-country terrain.  
 - Complete model validation of differential torque steer and mature the control architecture enabling volume-efficient wheeled combat vehicles.  
  
 - Complete design of advanced high efficiency mechanical transmission enabling reduced vehicular fuel consumption and increased transmission power density.  
 - Fabricate turbocharger, high temperature tribology componentry, cold start system and fuel injection system for application to commercial diesel engines for combat vehicles.  
 - Mature band track with enhanced mine resistant characteristics.
- 2924 - Mature new system level and component level vehicle power requirements based on the Future Combat Systems (FCS) characteristics. Allocate these requirements down to a vehicle hybrid electric power architecture.  
 - Using the CHPS virtual prototype modeling tools, design vehicle-specific hybrid electric architecture.  
 - Build advanced componentry for incorporation into CHPS SIL architecture which to support the FCS designs.
- 1621 - Test advanced components (e.g., high power/high energy pulse forming network, flywheel, high temperature/fast response converters and advanced high energy density batteries) for performance assessment in CHPS SIL.
- 159 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 7410

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

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BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

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**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT

**441**

## FY 2002 Planned Program

- 4732 - Test advanced components of CHPS hardware on a mobility test bed to demonstrate robustness and fuel efficiency for combat vehicles.
  - Finalize new system level and component level vehicle power requirements based on results of CHPS SIL testing and experimentation.
  - Finalize vehicular requirements incorporating results of CHPS SIL experimentation representing state of the art validated and fully optimized vehicle hybrid electric power architecture.
  - Finalize advanced componentry design and integrate into vehicular architecture reflecting potential FCS configuration.
- 10000 - Initiate demonstration of at least two competing high power density engines to meet FCS power, size, and weight constraints (i.e., twice the horsepower per cubic foot and half the weight of comparable commercial engines).

Total 14732

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT  
**497**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
497 COMBAT VEHICLE ELECTRO	5625	2969	5616	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides key enabling technologies required to transform the Army to the rapidly deployable Objective Force. It develops and demonstrates intra-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. Current efforts leverage semi-autonomous robotics technologies (e.g., automated driving) for application to manned systems to reduce crew work load. Efforts will culminate in an FY 2004 vehicle demonstration of the ability to perform crew functions associated with fighting, performing reconnaissance and carrying troops for a two-man crew vehicle. Goals include a 30% reduction in software cost, a 10 times increase in architecture throughput, and full mission rehearsal via embedded simulation that will be relevant to the FCS. Major contract efforts will include: DCS Corp, Alexandria, VA; Oasis, Troy, MI; and RST, Westminster, MD. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

- 1558 - Completed fabrication and integrated crew stations into testbed.
- 1944 - Completed soldier testing of crew station demonstrator to provide feedback on indirect vision, voice recognition, three-dimensional audio.
- 896 - Integrated synchronized Modular Semi-Automated Forces (MODSAF) and after action review functionality into an embedded simulation system.
- 487 - Performed soldier training on advanced technologies crew stations in crew station SIL.
- 740 - Completed analysis of FCS mission profile and workload to derive requirements for multi-mission (Fight, Scout, Carrier and Unmanned System) crew stations.

Total 5625

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT

**497**

## FY 2001 Planned Program

- 638 - Conduct vehicle test bed data reduction and analysis; identify lessons learned for application to reduced volume crew stations to meet FCS deployability requirements.
- 1934 - Design advanced architecture reduced volume crew stations, incorporating semiautonomous driving and embedded simulation system.
- 344 - Participate in Future Combat Command and Control experiment at Mounted Maneuver Test Facility (Fort Knox, KY) to allow for early FCS experimentation of multi-mission crew stations/systems.
- 53 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2969

## FY 2002 Planned Program

- 1250 - Define semi-autonomous driving interface for integration into mobile reduced crew testbed.
- 900 - Adapt cognitive decision aids for ground systems for integration into mobile reduced crew testbed.
- 750 - Mature route planning software for integration into mobile reduced crew testbed.
- 1822 - Complete SIL to allow early evaluation of advanced crew station, electronics architecture and embedded simulation technologies by FCS contractors.
- 894 - Implement testbed architecture in SIL.

Total 5616



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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603005A - Combat Vehicle and Automotive Advanced Tech</b>				PROJECT <b>515</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
515     ROBOTIC GROUND SYSTEMS	0	1746	9300	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project has been specifically focused at providing a near-term unmanned system technology to the FCS program. The project funds technological maturation and demonstration of unmanned follower technologies required for multiple, potential tactical and logistics applications. Near-term efforts are oriented toward: (1) demonstrating technologies required for systems to move autonomously over terrain at militarily significant speeds, (2) maturing the technologies for transition to FCS and (3) conducting system of systems field experimentation to allow Warfighter and FCS contractor evaluation of the technologies. The Army's approach builds upon previous and ongoing investments, such as the Demo III program being conducted under the Joint Robotics Program Office with the ARL. The main effort funded in the project is the Robotic Follower Advanced Technology Demonstration (ATD). Additionally, the Army is investing on improving the flexibility and utility of unmanned ground vehicles (UGVs) by applying advanced technologies and algorithms to decrease the frequency of human intervention and direct control and implementing a robotic leader initiative for scout/reconnaissance missions. Technologies proven in robotic demonstrations are expected to be transferable to other unmanned platforms as well as manned platforms to reduce operator workload. This project was established by the Army in recognition of the increasing maturity of robotics technology, growing User interest in unmanned platforms, and an urgent need to make the force lighter, more agile strategically and tactically and more survivable. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

Project not funded in FY 2000.

**FY 2001 Planned Program**

- 627 - Perform analysis of leader follower robotics technologies and supporting operational concepts.
- 582 - Identify baseline and standard architecture for intelligent control of baseline vehicle demonstrator.
- 485 - Develop modeling and simulation capability to support robotics technology analysis for platform integration.
- 52 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1746

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT  
**515**

## FY 2002 Planned Program

- 529 - Model sensors, representative terrain and ARL autonomous mobility algorithms.
- 500 - Complete development of intelligent control architecture.
- 950 - Implement Demo III autonomous mobility algorithms as baseline.
- 900 - Design unmanned follower control interface for manned lead vehicle.
- 1421 - Perform system integration for field demonstration at Technology Readiness Level (TRL) 5 in FY 2003.
- 5000 - Demonstrate perception and control technologies to allow UGVs to operate in a tactical environment with less frequent human intervention than the Robotic Follower.
  - Develop a robotic lead vehicle for a FCS scout mission demonstration.
  - Equip robotic lead platform with Recon sensors for User evaluation.

Total 9300

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603005A - Combat Vehicle and Automotive Advanced Tech</b>					PROJECT <b>53G</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
53G FUTURE COMBAT SYSTEMS (FCS)	0	0	111560	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project funds the Army's share of the cost shared Army/DARPA collaborative FCS program. This project was established by means of a zero sum transfer of funds from project 440 to separate this project to provide better visibility to this high priority program. DARPA is the executive agent and the majority of the funds in this project are provided to and executed by DARPA in accordance with the MOA signed in February 2000. Under terms of the MOA, the Army committed to provide the following funding: \$107M (FY 2002), \$122M (FY 2003), \$114M (FY 2004) and \$111M (FY 2005) for a single contractor demonstration of three of the FCS functions and cost sharing of selected Army/DARPA FCS enabling technologies in Robotic Unmanned Ground Vehicle, Maneuver Command and Control Communications, Maneuver Beyond-line-of-sight (BLOS) Networked Fires Weapon, and BLOS Surveillance and Targeting System. In addition, the Army will provide full funding for demonstration of the other four functions that will make up the entire system-of-systems of the Army/DARPA FCS program. This program responds to a draft Mission Needs Statement issued by the U.S. Army Training and Doctrine Command and the Army Vision. FCS is the centerpiece of the Army's strategy to achieve the Objective Force. It is a multi-functional, system of systems that will be capable across the full spectrum of operations. The Army plans to field FCS in this decade. The program is now in the concept design phase with four Section 845 Agreements in place (funded in Project 440 and PE 0602601A, project HH7). The four teams are: Full Spectrum Team, The Boeing Company, Gladiator Consortium, and FoCus Vision Consortium. In May 2002, DARPA will modify this agreement to select two or more team(s) to continue the development of a final design of their FCS concepts. This modification will expand the efforts to define the details of each of their concepts and provide detailed architectures for Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), software and hardware, and draft plans for logistics support, environmental issues, training, and production (e.g. long lead items, processes). In April 2003, the Army Leadership will make a decision on the technical readiness of one or more of the designs to enter into a final design, build and demonstration phase, and, given an affirmative decision, DARPA will issue a modification to their Other Transaction 845 for up to two Contractor Teams for this final design, system architectures, building of functional demonstrators, and the delivery of detailed design of selected components. Concepts and architectures must be detailed and implementation plans ready to execute. During this final design, integration of the demonstrators, and the demonstration itself, it will be necessary to work concurrently with still developing technology packages to integrate the necessary capabilities into the demonstrator. The system of systems capability will be demonstrated by FY 2006 through a series of demonstrations in conjunction with modeling and simulation. The contractor(s) will be expected to demonstrate the complete set of system of system functionalities and how all the capabilities will be successfully integrated together both hardware and software. Contractors supporting the FCS program are:  
 Full Spectrum Team - SAIC, United Defense, SPL, VRI, Omnitech Robotics, LMI, SRI International, ITT Industries, CEM, Northrop Grumman  
 The Boeing Company - NID, WB&B, VRI, Signature Research, Rockwell Science Center, NIST, Krauss-Maffei Wegmann (KMW)  
 Gladiator Consortium - IITRI AB Tech Group, Carnegie Mellon, Lockheed Martin, CSC, Battelle, TRW  
 Focus Vision Consortium - General Dynamics Land Systems, SRI International, Halliburton Company, Coates & Jarratt, Inc

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT

**53G**

., Raytheon, Honeywell, Electrical & Computer Engineering, Maxwell Technologies, Carnegie Mellon, WB&B, Sensis Corporation, BAE Systems, Aurora, Sensor.com  
The final product will be a system of systems that will meet the Army's transformation goals to be strategically and logistically superior in all aspects and will support the Objective Force transition path of the TCP.

## FY 2000 Accomplishments

Program funded in Project 440

## FY 2001 Planned Program

Program funded in Project 440

## FY 2002 Planned Program

- 28586 - Funds Army's share of Army/DARPA collaborative FCS core program as follows:
  - Perform FCS tradeoff and technology analyses; develop detailed cost, schedule, performance objectives; recompute prime contractors for preliminary design phase.
  - Complete force level modeling and simulation efforts to support FCS concepts/Objective force employment and downselect decisions.
  - Complete evaluation of Army/DARPA FCS initial objective force concepts.
  - Select Army/DARPA FCS prime contractors to begin detailed designs of selected demonstrators.
- 79000 - Fund Army's share of the Army/DARPA FCS enabling technologies as follows:
  - Autonomous Navigation (Preceptor); develop detailed design of sensors and preception algorithms for autonomous vehicle designs.
  - Unmanned Ground Vehicle Program; downselect and begin detailed design of 600 Kg and 6000 Kg. unmanned ground combat vehicles.
  - Netfires; finalize missiles design and build hardware for flight test.
  - LADAR through the Canopy (Jigsaw); finalize LADAR design and begin hardware build.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603005A - Combat Vehicle and Automotive  
Advanced Tech**

PROJECT

**53G**

**FY 2002 Planned Program (Continued)**

- 3496 - Provide Army Objective Force Task Force support for FCS analysis and program integration.
- 478 - Initial funding for the other four system functions not provided for in the MOA for Army/DARPA FCS program.

Total 111560

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603006A - Command, Control and Communications Adv  
Tech**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	27442	28243	31865	0	0	0	0	0	0	0
247 TAC C4 TECHNOLOGY INT	11042	12315	13893	0	0	0	0	0	0	0
257 DIGITAL BATTLEFLD COMM	4630	3778	12780	0	0	0	0	0	0	0
592 SPACE APPLICATION TECH	5088	5215	5192	0	0	0	0	0	0	0
596 FIELD LASER RADAR DEMO	6682	0	0	0	0	0	0	0	0	0
59A INTELLIGENCE ANALYSIS ADVANCED TOOL SET	0	3963	0	0	0	0	0	0	0	0
59B BIG CROW PROGRAM OFFICE SUPPORT	0	2972	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The goal of this program element (PE) is to provide the Army's Objective Force with the distributed, mobile, secure, fully automated, self organizing communications networks required to ensure the lethality, mobility, agility and deployability of the Objective Force. The capability to seamlessly integrate communication and networks across all layers, including unattended systems and sensor layers, maneuver layers and space layers, will be addressed. This goal will be attained by maturing and demonstrating new and improved command, control, communications, and networking technology. Commercial communication technologies will be continuously investigated and leveraged, whenever possible. The Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) Advanced Technology Demonstration (ATD) will provide the communications technology foundation that seamlessly and automatically supports high volume, secure multimedia traffic in a dispersed On-The-Move (OTM) fashion. The Tactical Command and Control (C2) Protect ATD will provide protection technologies for tactical networked systems against modern network attacks. The space applications technology project will demonstrate novel applications of space assets for Army missions and support space technology integration. Smart sensor networking technologies will provide the ability to network and control unmanned systems anywhere on the battlefield, providing a timely sensor-decider-engagement linkage to defeat critical targets. Advanced antenna technologies will provide the Objective Force and Joint Tactical Radio System (JTRS) with greater communications mobility, range and throughput. These projects mature technology to integrate communications systems and prototype products to enhance the survivability and efficiency of Army Objective Force tactical Command, Control, Communications and Computer (C4) systems. This program also tests and evaluates networked radio, common user, advanced antenna concepts, and distributed communications equipment and automated network management aids in conjunction with the Defense Advanced Research Projects Agency (DARPA) and the other services. The cited work 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), 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

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603006A - Command, Control and Communications Adv  
 Tech**

Computer Science and Sensor Technology), and PE 0603789F (C3I Technology Development) in accordance with the ongoing Reliance Joint Planning Process. The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command (CECOM), Fort Monmouth, NJ.

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	27612	21505	23775	0
Appropriated Value	27883	28505	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-670	0	0	
c. Omnibus or Other Above Threshold Reductions	-103	0	0	
d. Below Threshold Reprogramming	500	0	0	
e. Rescissions	-168	-262	0	
Adjustments to Budget Years Since FY2001 PB	0	0	8090	
Current Budget Submit (FY 2002/2003 PB )	27442	28243	31865	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for Intelligent Analysis Advanced Tool Set for evaluation on all source analysis system(+4000) and Big Crow Program Office Support (+3000).

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

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Tech**

FY 2002: Additional funds (+8000) were added for command and control on-the-move technical test and demonstration.



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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603006A - Command, Control and Communications Adv Tech</b>					PROJECT <b>247</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
247 TAC C4 TECHNOLOGY INT	11042	12315	13893	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures network and communications technology options for the Objective Force, leveraging commercial technologies where applicable, to support mission planning and battlefield decision making. This project includes the MOSAIC ATD, with the maturation, adaptation, and integration of communications for mobile operations required for the Objective Force, and is also funded in the D257 Project. The MOSAIC ATD will mature and demonstrate the core self-organizing, ad hoc, mobile network capability. It will use an open architecture approach via application program interfaces to enable integration of other capabilities and technologies. It also will demonstrate the integration of the basic maneuver layer to all other layers. In addition, this project includes the Tactical C2 Protect ATD that provides protection technologies for tactical network command and control information systems, components and data, against modern network attacks. This project performs maturation of OTM ultra-high frequency (UHF), super high frequency (SHF), and extremely high frequency (EHF) satellite communications technology, with the reachback communications capability required to reduce the number of personnel deployed into a theater of operations. Additionally, this project is maturing technologies that are required for a complete JTRS. Finally, the project matures a family of highly efficient, practical, cost effective antennas and subordinate products covering the 30 MHz to 44 GHz frequency range. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4426 - Investigated and evaluated information protection technologies for the upper Tactical Internet (TI) with focus on network access protection, intrusion detection and host level protection.  
- Integrated and tested C2 protection solutions in a field environment.
- 3680 - Integrated wideband power amplifier control signal interface within the Wideband Radio Network (WRNT).  
- Conducted initial evaluation of the UHF multiplexer.  
- Investigated and matured an extended frequency wideband power amplifier (EF-WBPA) (400-2000 Mhz).  
- Integrated laboratory testbed equipment within the WRNT.
- 1785 - Conducted an initial review of existing and proposed (low earth orbit (LEO)/ medium earth orbit (MEO)) wideband commercial satellite communication (SATCOM) technologies and capabilities. Matured a fast recovery modem for EHF OTM narrowband communication.  
- Conducted an initial evaluation of the JTRS multiband OTM antenna prototypes.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603006A - Command, Control and Communications  
Adv Tech**

PROJECT

**247**

## FY 2000 Accomplishments (Continued)

- Matured modeling and simulation tools to evaluate performance of multiple antennas on multiple vehicles used in Tactical Operation Centers (TOCs).

- 1151 - Matured, fabricated and tested alternative technologies for phased array antennas with goal of cost reduction.

Total 11042

## FY 2001 Planned Program

- 6309 - Expand the investigation and evaluation of information protection technologies for the upper TI to address security management and malicious code detection and eradication.
- 3450 - Integrate very high frequency (VHF)/UHF radio frequency (RF) receiver/transmitter multiplexer into a single unit.
  - Conduct performance testing on the Wideband Power Amplifier (WBPA) (30-450MHz).
  - Conduct performance testing on the EF-WBPA.
  - Demonstrate JTRS compatible OTM antenna.
  - Conduct co-site performance test evaluation of UHF multiplexer.
- 2223 - Evolve a fast recovery modem for Ka band LEO/MEO OTM SATCOM wideband communication.
- 333 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 12315

## FY 2002 Planned Program

- 7092 - Investigate and evaluate information protection technologies for the upper TI with emphasis on tactical public key infrastructure (PKI) pilot and advanced intrusion detection to include neural networking.
  - Investigate and evaluate information protection technologies for the upper TI with emphasis on tactical public key infrastructure (PKI) pilot and advanced intrusion detection to include neural networking. Demonstrate integrated Tactical C2 Protect ATD technologies that provide protection for TI C2 information systems, components and data, against modern network attacks.
- 2459 - Validate OTM link layers protocols, to include recovery from blockages.
  - Integrate JTRS OTM multiband ground antennas to improve design and performance.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603006A - Command, Control and Communications  
Adv Tech**

PROJECT

**247**

## FY 2002 Planned Program (Continued)

- 4342 - Test and evaluate MOSAIC system model in computer modeling and simulation environment.
  - Integrate MOSAIC communications and networking protocol technologies into MOSAIC mobile testbed.
  - Perform initial MOSAIC limited field demonstration.

Total 13893

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603006A - Command, Control and Communications  
Adv Tech**

PROJECT  
**257**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
257 DIGITAL BATTLEFLD COMM	4630	3778	12780	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This Project jointly funds with PE/project 0603006A D247 the Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) ATD. The goal of the MOSAIC ATD is to provide the Army's Objective Force with networked communications capability that support short range dispersed wireless elements (less than 1 km), medium range dispersed wireless elements (less than 10 km) and extended range dispersed wireless elements (greater than 10 km). Multiple wireless transmission facilities provide the user flexibility to traverse varied terrain over wide areas, which can improve system robustness and reduce vulnerability. The overall system will provide a scaleable capability so the user has the best wireless communications system available based on current operating conditions. The selection of these multiple wireless systems will be automated to ease the burden on the operator. To provide this highly reliable mobile communications infrastructure, the communications assets will seamlessly assign bandwidth as a function of range and network conditions. In addition, automated reconfiguration of the routing protocols, without operator intervention, will occur. This program will use airborne communications payloads to provide a networked, beyond line of sight, capability and allows maneuver elements to be dispersed in excess of 15 km to support split based operation associated with early entry Objective Force operations. The ability to seamlessly and automatically support multimedia traffic and sensor data over variable range and bandwidth transmission systems while vehicles are in motion will also be demonstrated. Mobile elements will demonstrate minimally interrupted communications, which support data, voice, remote sensor networking, real time multimedia and video teleconference (VTC) services. To show connectivity in this ATD, the communications system will dynamically operate over several different transmission systems, including a wireless local area network (LAN), packet radio, wideband cellular radio, unmanned aerial vehicles (UAVs), and satellites. This project includes Smart Sensor Communications Networks (SSCN), which will provide the Objective Force with the ability to task unmanned sensors and transport data and images from them to data fusion points and tactical commanders using the information sphere. SSCN will leverage a variety of efforts including the DARPA Small Unit Operations (SUO) and Sensor Information Technology (SensIT) programs as well as technologies developed by Army Research Laboratory (ARL). This program supports the Objective Force transition path of the Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2014 - Matured a security architecture to consider MOSAIC security issues up front and generated solutions to improve performance and reduce costs.
- Extended 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.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603006A - Command, Control and Communications  
Adv Tech**

PROJECT  
**257**

## FY 2000 Accomplishments (Continued)

- Evolved capability to enhance communications services (voice, data, video, e-mail, web browsing, video conferencing, etc.) to mobile, wireless tactical user.
- 2616 - Investigated and identified communications technologies to support distributed mobile wireless tactical operations centers.
- Identified and matured key technologies developed under the DARPA Global Mobile (GloMo) program to support networked OTM communications.
- Analyzed and matured communications architecture for the Objective Force.

Total 4630

## FY 2001 Planned Program

- 3703 - Integrate networking and link layer technologies for the future generation tactical internet into the MOSAIC mobile testbed.
- Explore methods to achieve guaranteed QoS associated with real-time, IP based, multimedia communications over tactical backbone networks.
- Enhance security of commercial personal communications technology currently being adapted to tactical applications.
- Leverage commercial wireless LAN technology to provide fast Ethernet connectivity for mobile and ad-hoc networks. Adapt ad-hoc protocols to support self-initializing, self-healing, adaptive mobile networks.
- Integrate and mature DARPA program technologies into the MOSAIC mobile testbed that support networked OTM communications.
- Establish modeling and simulation environment of models provided by protocols/mechanisms.
- Evaluate and integrate key extended range networked communications technologies with the MOSAIC mobile testbed.
- 75 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 3778

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603006A - Command, Control and Communications  
Adv Tech**

PROJECT

**257**

## FY 2002 Planned Program

- 12780 - Adapt and integrate protocols, agents and proxies that perform horizontal and vertical hand-off for optimal network operations.
  - Integrate IP QoS into MOSAIC systems architecture.
  - Integrate ad-hoc network protocols that support self-initializing, self-healing, adaptive, mobile networks.
  - Adapt and integrate initial bandwidth management mechanisms into the MOSAIC systems architecture.
  - Leverage and adapt commercial/government off-the-shelf (COTS/GOTS) mobile addressing mechanisms.
  - Investigate power management protocols suitable for sensor networks and extend the baseline for refined requirements.
  - Integrate hardware and software in surrogate ground and air platforms for technical laboratory and field tests of command and control on the move capability using an ad hoc self-organizing network with 6-10 platforms over short (1km), medium (10km), and extended (50km+) ranges.

Total 12780

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603006A - Command, Control and Communications Adv Tech</b>					PROJECT <b>592</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
592 SPACE APPLICATION TECH	5088	5215	5192	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project develops, demonstrates and transitions advanced space technology applications for the Army's Objective Force. It develops space force enhancement applications for intelligence, reconnaissance, surveillance, target acquisition, position/navigation, missile warning, and space control ground-to-space surveillance, negation and battle management/C4 capabilities. Advanced space technologies include electro-optical (EO), infrared (IR), multi/hyperspectral, synthetic aperture radar sensors, ground-to-space radar, directed energy, and advanced data collection, processing and dissemination in real and near real time. Additionally, the project demonstrates, evaluates, and defines Army technical requirements for space platform/sensor development, on orbit sensor data collection and processing, satellite tasking and direct downlink data dissemination to ground/air systems. The project provides algorithms that optimally process space sensor data in real and near real time for integration into battlefield operating systems. Provides space control advanced technology risk reduction capability for ground-to-space radar surveillance and space object negation (disrupt, degrade, deny and destroy) systems development. Also provides an advanced space technology base for the space and missile defense battlelab space exploitation and demonstration program and the Tri-Service Department of Defense (DoD) space test program. This program supports the Objective Force transition path of the Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1210 - Demonstrated a hyperspectral sensor in the 1-2.5 micron wavebands, and improved cueing and clutter rejection via polarization using ground test. Initiated Long Wave Infrared (LWIR) Acousto-Optic Tuneable Filter (AOTF) development.
  - 3393 - Demonstrated Battlefield Ordnance Awareness (BOA) IR sensor ability to detect artillery and rocket firings; developed software for identification and targeting of simultaneous explosive ordnance events; collected signature data in various tactical environments.
  - 485 - Evolved radar phenomenology documentation and completed conceptual space surveillance technology design requirements.
- Total 5088

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE	PROJECT
<b>0603006A - Command, Control and Communications Adv Tech</b>	<b>592</b>

**FY 2001 Planned Program**

- 986 - Demonstrate on board, near-real time, spectral/polarization data processing, and hyperspectral spatial and temporal signature processing with sensor in tower tests. Complete LWIR AOTF development.
  - 3032 - Complete BOA IR signature database development; demonstrate algorithms for near real time processing of ordnance events in airborne tests; develop initial set of Army technical ordnance reporting requirements for integration in intelligence, fire support and DoD space based IR systems.
  - 1057 - Complete space surveillance threat database development and evaluate potential image correlation process algorithms for technology demonstration.
  - 140 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 5215

**FY 2002 Planned Program**

- 1094 - Field test an integrated sensor on an aerial platform and measure performance against camouflaged and concealed tactical targets. Assess performance of LWIR AOTF and focal plane array. Define LWIR hyper spectral sensor design for aerospace test platforms.
  - 994 - Complete battlefield ordnance technical requirements definition. Transition to intelligence, fire support, and DoD space based IR systems.
  - 3104 - Develop formal software coding of algorithms user interface design to demonstrate threat assessment techniques on space surveillance radar.
- Total 5192



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603007A - Manpower, Personnel and Training Advanced Tech**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	4887	7008	3120	0	0	0	0	0	0	0
792 PERSONNEL PERFORMANCE & TRAINING	4887	5026	3120	0	0	0	0	0	0	0
79A ARMY TRAINING SUPPORT CENTER	0	1982	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The objective of this program element (PE) is to develop and demonstrate advanced soldier-oriented technologies to enhance soldier and unit performance in the Army's transformation to the Objective Force. A key goal of this program is the reduction of training and other personnel costs through the development of effective training strategies that incorporate appropriate mixes of live, virtual, and constructive simulations. Research and development (R&D) efforts include designing new ways to efficiently develop collective training; developing and demonstrating prototype training methods and programs that improve mission performance; devising training strategies using distributed training technology to conduct multi-site training, assessment, and feedback; and evaluating the effectiveness of compressed gunnery training strategies for the Reserve Component. R&D will also design innovative methods and technologies to develop effective leaders for small team operations and for developing Battle Commanders for the digitized battlefield. Work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This PE is managed by the U.S. Army Research Institute (ARI) for the Behavioral and Social Sciences. This program supports the Objective Force transition path of the Transformation Campaign Plan(TCP).

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603007A - Manpower, Personnel and Training Advanced Tech**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	4981	3072	3115	0
Appropriated Value	5030	7072	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-94	0	0	
c. Omnibus or Other Above Threshold Reductions	-14	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-35	-64	0	
Adjustments to Budget Years Since FY2001 PB	0	0	5	
Current Budget Submit (FY 2002/2003 PB )	4887	7008	3120	0

Change Summary Explanation: Funding - FY 2001 Congressional adds were received for Aircrew Coordination Training (+2000) and Assistance to Army Training Support Center/Learning Systems Institute for development and evaluation of reusable educational software packages(+2000).

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

June 2001

**BUDGET ACTIVITY**  
**3 - ADV TECHNOLOGY DEV**

**PE NUMBER AND TITLE**  
**0603007A - Manpower, Personnel and Training**  
**Advanced Tech**

**PROJECT**  
**792**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
792 PERSONNEL PERFORMANCE & TRAINING	4887	5026	3120	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this program element(PE) is to develop and demonstrate advanced soldier-oriented technologies to enhance soldier and unit performance in the Army's transformation to the Objective Force. A key goal of this program is the reduction of training and other personnel costs through the development of effective training strategies that incorporate appropriate mixes of live, virtual, and constructive simulations. Research and development (R&D) efforts include designing new ways to efficiently develop collective training; developing and demonstrating prototype training methods and programs that improve mission performance; devising training strategies using distributed training technology to conduct multi-site training, assessment, and feedback; and evaluating the effectiveness of compressed gunnery training strategies for the Reserve Component. R&D will also design innovative methods and technologies to develop effective leaders for small team operations and for developing Battle Commanders for the digitized battlefield. Work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This PE is managed by the U.S. Army Research Institute (ARI) for the Behavioral and Social Sciences. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4887 - Developed refined performance assessment tools for Force XXI unit training in the Close Combat Tactical Trainer (CCTT) and other simulation environments.
- Developed Laser Marksmanship Training System (LMTS) tool for predicting Army Reserve soldier rifle marksmanship qualification, for U.S. Army Reserve Command (USARC) use in reducing live-fire time and ammunition needed for qualification purposes..
- Tested synchronous distributed training of complex cognitive skills and observed 35% improvement over current training methods.
- Designed prototype Special Forces recruiting strategies and adaptability assessment tools that enhanced the SF assessment and development process.
- Assessed the Army's current command climate and identified to senior leadership issues of concern to soldiers.
- Based on a one-year Congressional add for Aircrew Coordination Training, initiated development and demonstration of prototype crew coordination training program.

Total 4887

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603007A - Manpower, Personnel and Training  
Advanced Tech**

PROJECT

**792**

## FY 2001 Planned Program

- 2933 - 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 trends and new issues of concern to soldiers.
  - Test Internet delivery of collaborative learning versus platform instruction.
  - Develop preliminary guidelines for use by the U.S. Army Intelligence School to train cognitive skills and declarative/factual knowledge using distributed learning technologies.
- 1989 - The objective of this one-year Congressional add is to complete development and demonstration of an aircrew coordination training program.
- 104 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5026

## FY 2002 Planned Program

- 3120 - Plan the computer automation of certain instructor functions in collaborative learning environments.
  - Evaluate the training of digital procedures for soldiers through distributed learning over the Internet.
  - Conduct annual assessment of Army command climate and trends over time, and identify new issues of concern to soldiers.
  - Determine training requirements for mounted units as part of contingency force operations.
  - Identify the training/coaching strategies and mentoring processes effective leaders use to develop individuals in team contexts.
  - Determine impact of increasing training demands (PERSTEMPO) on Reserve Component (RC) turbulence and attrition.

Total 3120

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603105A - Military HIV Research</b>					PROJECT <b>H29</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H29 MED PROTECT AGNST HIV	5771	5834	5937	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This project supports the "Medical" technology area of the Objective Force by conducting concept exploration of candidate vaccines to include safety and efficacy in model systems to prepare and conduct clinical studies. It funds Acquired Immune Deficiency Syndrome (AIDS) research to control the infection in military environments, protect the military blood supply, and protect military personnel from risks associated with infection. AIDS research is focused on the following areas: diagnosis, natural history, epidemiology, and vaccine development. Preclinical trials and phase 1, 2, and 3 clinical trials are performed as required for drug and vaccine licensure with US Food and Drug Administration. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Major contractors are the Henry M. Jackson Foundation, Rockville MD and the Armed Forces Research Institute of Medical Science, Bangkok, Thailand. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 5771 - Completed a phase 2 clinical trial that demonstrated the safety (preliminary data) of a strain-specific (subtypes B and E) vaccine candidate in Thailand. Immunogenicity data is pending data scrub.
- Began a phase 1/2 clinical trial of a strain-specific (subtypes B and E), canary pox-vectored HIV vaccine in Thailand. Conducted long-term follow-up of vaccine trial in human volunteers in Thailand. Study of follow-up results is underway.
- Conducted phase 1 clinical trials of complex protein and novel vectored candidate vaccines. Conducted a phase 1 clinical study of Therapore-HIV vaccine in the U.S. Study of results is underway.
- Conducted studies to develop/select a method for genotyping clinical HIV isolates for drug resistance for use in clinical management of military personnel with HIV infection.
- Based on preliminary testing data, selected 3 candidate rapid test devices for HIV for further development and licensure for use in medical management of U.S. military personnel after exposure to blood or blood products and for emergency screening of blood donors and/or supplies.

Total 5771

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603105A - Military HIV Research**

PROJECT  
**H29**

## FY 2001 Planned Program

- 5660 - Conduct specialized laboratory studies of HIV virus and human host cell interactions, including virus entry into human cells, targeting of HIV vaccines to human immune cells, binding of candidate vaccines to human immune cells, and studies of HIV virus and immune system factors that are associated with immunity.
  - Conduct phase 1 and 2 clinical trials of candidate vaccines and novel vaccine delivery systems to test safety and the ability to produce an immune response.
  - Prepare a field site for large-scale field trials of candidate vaccines including an epidemiological study of the test population, preparation and education of population test cohorts, and establishing the trial site infrastructure.
  - Conduct a clinical study of the benefit of drug resistance testing on clinical management of HIV-infected patients. Continue to evaluate promising rapid tests with large volume testing. Data will support and stimulate further commercial development and licensure by commercial manufacturers.
- 174 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5834

## FY 2002 Planned Program

- 5937 - Conduct specialized laboratory studies to define HIV virus and immune system factors that are associated with immunity.
  - Conduct phase 1 clinical trials of candidate vaccines and novel vaccine delivery systems (e.g., recombinant anthrax-vectored vaccine and VEE replicon particles) to test safety and the immune response.
  - Continue preparations for large-scale field trials including, epidemiological study of the test population, preparation and education of population test cohorts, and preparation of trial site infrastructure.
  - Conduct extensive testing of candidate rapid HIV testing devices to allow selection of the best devices to develop HIV testing algorithms applicable to field settings, including hospitals, troop medical clinics and blood banks.

Total 5937

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603105A - Military HIV Research**

PROJECT  
**H29**

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	5931	5889	5911	0
Appropriated Value	5976	5889	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-160	0	0	0
c. Omnibus or Other Above Threshold Adjustments	-24	0	0	0
d. Below Threshold Reprogramming	0	0	0	0
e. Rescissions	-21	-55	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	26	0
Current Budget Submit (FY 2002/2003 PB )	5771	5834	5937	0

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603238A - Air Defense/Precision Strike Tech</b>					PROJECT <b>177</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
177 JT ALS PS DEMO	24911	21112	32267	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The goal of this program element is to use and demonstrate maturing technologies to locate, identify, and kill high-value and time-critical targets to work Joint Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) seams, to assess damage within tactically meaningful timelines, and to evaluate sensor-to-shooter and other capabilities for the Objective Force. This work is closely coordinated with the other Services, OSD and the User community to seek joint solutions, new operational concepts, and joint concept development. The Theater Precision Strike Operations (TPSO) ACTD, initiated in FY 1998, is providing the Commander in Chief, United Nations Command (CINCUNC) (Korea) a significantly enhanced Theater wide capability for the CINC to plan and conduct Counterfire and Precision Strike Engagements through the real-time/near-real-time synchronization of US/Coalition assets through application technologies. Joint Intelligence, Surveillance and Reconnaissance (JISR) ACTD initiated in FY 2000 will implement a tactical networked sensor grid using internet web based technologies to horizontally integrate tactical and operational level ISR information from existing stove-piped legacy service and joint C4ISR systems and nontraditional tactical sensors (such as Firefinder radar and unattended ground sensors). Warfighters will be able to access and geospatially visualize all available ISR information using any workstation equipped with a browser. In FY 2002 the JISR ACTD will integrate additional Joint ISR sensors and sources to include the Global Command and Control System (GCCS), GCCS-Improved Imagery and Intelligence (GCCS-I3), GCCS-Maritime (GCCS-M), Guardrail Common Sensor, Tactical Exploitation System (TES), Tactical Control and Analysis Center (TCAC), and Firefinder radar. Joint Continuous Strike Environment (JCSE) ACTD will provide the CJTF with automated target prioritization, continuous weapons availability monitoring, optimized weapon-target pairing and dynamic airspace deconfliction. The Integration and Evaluation Center (IEC) combines live and simulated entities into a Joint virtual battlefield testbed for designing, conducting, measuring, and assessing, and evaluating system of systems designs, demonstrations, and experiments to identify and quantify system solutions for Joint C4ISR and system solutions. The IEC technology is the base for Simulation Based Acquisition evaluations. FY 2002 will continue the JCSE and TPSO ACTDs participation and support into CINCUNC warfighting exercises, increasing the functionality for the Joint Warfighter Applications into warfighter units as well as finalize and execute transition and sustainment plans thru FY 2002-2003. This project is also developing the Joint Virtual Battlespace (JVB). The JVB project provides robust Simulation Based Acquisition (SBA) tools for system-of-systems analysis environment that facilitates the assessment of the acquisition decisions for the Future Combat System (FCS) and Objective Force (OF) operational concepts in a joint environment. JVB integrates existing models, creating a battlespace which can evaluate the synergy of system-of-systems designs as compared to individual component systems. No other tool is available in the Army to do this operational, constructive analysis. The JVB includes many facets of the battlespace, such as terrain interactions, weather effects, mobility, networked sensors, joint forces, and robotics. The JVB program was started in FY 2001 with funding programmed from PE 0603005A, Project 440 as part of a Congressional increase for FCS. In FY 2002-2003 the funding to continue JVB has is contain in this PE/Project. The increase in total funding in this PE from FY 2001 to FY 2002 is primarily due to the transition of the JVB funding into this PE.



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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603238A - Air Defense/Precision Strike Tech**

PROJECT

**177**

Additionally, the JISR ACTD was not funded from this PE in FY 2001, due to other Army priorities, but is funded in this PE again in FY 2002 and this is also contributing to the FY 2001 to FY 2002 funding increase. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no known duplication with any effort within the Military Departments. Work in this project is managed by the Director, Joint Precision Strike Demonstration (JPSD) Project Office at Fort Belvoir, VA. JPSD is a member of the Program Executive Office, Intelligence, Electronic Warfare, and Sensors (PEO-IEW&S), Fort Monmouth, NJ. The Prime contractor for the TPSO and JISR ACTDs is Raytheon Company, Bedford, MA. For the JCSE ACTD the prime contractor is General Dynamics - Information Systems, Arlington, VA. This program supports the Objective Science and Technology transition path of the Transformation Campaign Plan (TCP).

## FY 2000 Accomplishments

- 18776 - Participated in four major Commander-in-Chief United Nations Command (CINCUNC) warfighting exercises in the Korean theater to update previous documentation of functional requirements, and to integrate emerging technologies and capabilities for the Warfighter.
  - Planned and executed a demonstration, stimulated by simulations, of a counterfire battle for an unreinforced Korean scenario. Pre-prototype developmental systems in the Deep Operations Coordination Center were operated by United States Forces Korea (USFK) soldiers in a Man-in-the-Loop (MITL) mode for a proof of concept, early user evaluation in a realistic warfighting environment. These pre-prototype systems are compatible with Army Command, Control, Communication, Computers and Intelligence (C4I) acquisition programs. The demonstration included Republic of Korea (ROK) participation in counterfire fire requests and execution.
  - Conducted rapid prototyping operations at the JPSD Integration and Evaluation Center (IEC), in conjunction with the Depth and Simultaneous Attack Battle Lab (D&SABL) as well as Air Force, Navy and Marine Corps activities, to develop pre-prototype systems for the TPSO ACTD. The prototyping is designed to facilitate the coordination, planning and synchronization of joint and combined forces. The major effort is the development of Joint Warfighter Applications (JWA), which were leveraged from development provided during the previous CMRL ACTD. JWA is a software tool set that provides automated deep operations and coordination functions to support automated weapon paring and command and control functions.
  - Expanded, and upgraded the High Level Architecture (HLA) environment and automated Data Collection Architecture for the TPSO ACTD. This was used in FY 2000 and will continue to be used in FY 2001 to stimulate the Man-in-the-Loop (MITL) demonstrations. Provided the data collection capability required to make credible warfighting assessments.
  - Conducted technical reviews to assess the warfighting effectiveness of the emerging technologies integrated into the pre-prototype systems under development.
  - Supported Department of the Army-directed Greybeard North Korea Architecture Study.
- 817 - Validated and coordinated the Joint Continuous Strike Environment (JCSE) requirements in targeting Time Sensitive Surface Targets. Conducted a JCSE baseline demonstration during Fleet Battle Experiment - FOXTROT (FBE-F).

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>	PE NUMBER AND TITLE <b>0603238A - Air Defense/Precision Strike Tech</b>	PROJECT <b>177</b>
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**FY 2000 Accomplishments (Continued)**

- Tested the JCSE software for Build 2. Completed and began testing software for Build 3. Began requirements for Build 4.
  - Coordinated transition of JCSE ACTD product.
  - 1500 - Expanded the analytical capability of the JPSD Integration and Evaluation Center (JIEC). Provided additional connectivity to TRADOC Battle Labs and Joint Battle Center (JBC) to expand on current connectivities with Army, Air Force and Navy Battle Labs. Provided enhanced Joint user/developer testbed for rapid prototyping of new systems.
  - 3693 - Collected, documented and validated initial functional requirements and operational and systems architectures for Joint Intelligence Surveillance Reconnaissance (JISR) ACTD participants including U.S. Central Command, Third Army, Coalition Joint Task Force - Kuwait, and First Marine Expeditionary Force.
    - Established a distributed modeling and simulation environment to support development and assessment.
    - Developed and demonstrated an initial prototype capable of providing browser based access to JSTARS Common Ground Station moving target indicator (MTI) data, All Source Analysis System red force situation data, and GCCS-Army blue force situation data.
  - 125 - Provided support for Personal Recovery Software for the Personal Recovery Management System (PMRS) ACTD.
- Total 24911

**FY 2001 Planned Program**

- 19795 - TPSO ACTD will participate in CINCUNC warfighting exercises to refine, enhance, and expand the JWA and other functionality provided by pre-prototype systems demonstrated during the FY 2000 Demonstration.
  - Plan and execute a simulation/stimulated demonstration which will include aspects of a scenario representative of the transition from an unreinforced Korean Theater to a reinforced Korean Theater. Both ROK and U.S. forces will participate in a Man-In-The-Loop (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 JPSD IEC, Fort Belvoir, in conjunction with the Depth and Simultaneous Attack Battle Laboratory (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 2000 Demonstration.
  - Conduct technical reviews to assess the warfighting value added by each pre-prototype, residual system, and candidate system during the demonstration. Determine which candidate systems exhibit sufficient maturity and capability to warrant qualification as an ACTD "Leave Behind".

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603238A - Air Defense/Precision Strike Tech**

PROJECT

**177**

## FY 2001 Planned Program (Continued)

- Develop transition and sustainment plans to support the "Leave Behind" Systems for TPSO during the period of interim capability (FY 2002-2003), including a Battlespace Visualization system in the GCC DOCC; hardware system upgrades; provision of training support packages; and in-country support technical team and more than 200 JWA's, with some hosted on GCCS-K.
- 702 - Continue to evaluate and validate the value added of Joint Continuous Strike Environment (JCSE) system integration in laboratory tests and with Joint Battle Center evaluations.
  - Perform EUCOM Military assessment of JCSE ACTD.
  - Complete software Build 4 and continue participation in Joint exercises, including ULCHI FOCUS LENS (UFL) 2001.
  - JCSE will install Version 3.x software modules at 7th Air Force and in the USFK DOCC in Korea for UFL01; on the USS Coronado for Fleet Battle Experiment-India (FBE-I) and in the Combined Air Operations-Experimental (CAOC-X) at Langley AFB, VA.
- 615 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 21112

## FY 2002 Planned Program

- 13492 - TPSO ACTD will participate in CINCUNC warfighting exercises to refine, enhance, and expand the functionality provided by pre-prototype systems demonstrated during the FY 2001 Demonstration.
  - Support the four currently planned major CINCUNC exercises in the Korean theater, providing refined, expanded, and enhanced Joint Warfighter Application (JWA) functionality to the GCC DOCC and associated activities.
  - Conduct rapid prototyping operations at the JPSD IEC, Fort Belvoir, in conjunction with the D&SABL and Air Force, Navy and Marine Corps activities to refine the JWA functionality and improve the capability of the systems provided during the previous years of the ACTD.
  - Transition and sustain Joint Warfighter Applications into CINCUNC warfighter units.
  - Transition and sustain JWA into CENTCOM ARFOR (3rd Army) and in USAREUR (US V Corps) units.
  - Finalize and execute transition and sustainment plans to support the "Leave Behind" Systems for TPSO during the period of interim capability (FY 2002-2003), including a Battlespace Visualization system in the GCC DOCC; hardware system upgrades; provision of training support packages; and in-country support technical team and more than 200 JWA's, with some hosted on GCCS-K.
- 1772 - JISR ACTD will integrate additional Joint ISR sensors and sources to include the Global Command and Control System (GCCS), GCCS-Improved Imagery and Intelligence (GCCS-I3), GCCS-Maritime (GCCS-M), Guardrail Common Sensor, Tactical Exploitation System (TES), Tactical Control and Analysis Center (TCAC), and Firefinder radar.
  - Assess JISR system performance during the ARCENT LUCKY SENTINAL and Marine Expeditionary Force exercises and other tactical venues.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603238A - Air Defense/Precision Strike Tech**

PROJECT  
**177**

**FY 2002 Planned Program (Continued)**

- 725 - Continue to evaluate and validate the value added of Joint Continuous Strike Environment (JCSE) system integration.
  - Implement transition plan and have JCSE DII-COE compliant.
  - Demonstrate in Fleet Battle Experiment-JULIET (FBE-J) and Millennium Challenge 2002.
- 16278 - Integrate dynamic environment, NBC component simulations and conops/tactics into the JVB framework.
  - Integrate Joint Force on Force models with component simulations in the JVB framework.
  - Incorporate initial FCS contractor concepts/models in JVB.
  - Conduct virtual force on force experiments and provide data and results to the analysis community to support initial operational evaluations.
  - Integrate model federation from the Research, Development and Engineering Center community.
  - Incorporate additional models from the Department of Energy and other government agencies.
  - Evaluate FCS/Objective Force design concepts in urban environments.

Total 32267

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
President's Previous Budget (FY 2001 PB)	24435	21307	15997	0
Appropriated Value	24618	21307	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-649	0	0	0
c. Omnibus or Other Above Threshold Reductions	-99	0	0	0
d. Below Threshold Reprogramming	1125	0	0	0
e. Rescissions	-84	-195	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	16270	0
Current Budget Submit (FY 2002/2003 PB )	24911	21112	32267	0

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603238A - Air Defense/Precision Strike Tech**

PROJECT

**177**

Change Summary Explanation: Funding - FY 2002-2003: Funding increase to continue JVB FCS modeling and simulation, which started in FY 2001 with funding provided from the Congressional increase for FCS in PE/project 0603005A/440.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603270A - Electronic Warfare Technology**

COST (In Thousands)	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cost	15678	30575	13868	0	0	0	0	0	0	0
K15    ADVANCED COMM ECM DEMO	6709	5277	6584	0	0	0	0	0	0	0
K16    NON-COMMO ECM TECH DEM	8969	9941	7284	0	0	0	0	0	0	0
K19    MULTIPLE INTEL REMOTED SENSOR SYSTEM - BLK 1	0	12385	0	0	0	0	0	0	0	0
K20    SHORTSTOP	0	2972	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) matures and demonstrates multi-intelligence remote sensor technologies and Electronic Warfare (EW) systems in support of the Army's Objective Force commanders. It addresses the need to locate, disrupt or destroy the enemy's command, control, and communications (C3) systems and infrastructure. The goal of this PE is to significantly enhance the Objective Force's conduct of information operations (IO) to win the information war (IW). Both non-communications and communications applications are addressed by this PE. It also looks at communications countermeasures (CM) and communications counter-countermeasures (CCM) applications. Project DK15 provides technology demonstrations in CM, information collection and reporting to transition to Army intelligence and electronic warfare (IEW) systems. This transformation will be accomplished through the block improvement process. This project also supports demonstrations of automatic/automated fusion of intelligence, information, and data from multiple sources. Project DK16 focuses on the feasibility and effectiveness of non-communications Electronic Countermeasures (ECM) and electronic support/electronic intelligence (ES/ELINT). This project provides self-protection from radar, electro-optical (EO), and infrared (IR) guided anti-aircraft artillery, surface-to-surface missiles, artillery, and top attack weapons. Further, it provides precise targeting information on non-communications emitters. Technologies developed and matured as part of this PE will be demonstrated in the Integrated Situation Awareness (SA) and Targeting (ISAT) Advanced Technology Demonstration (ATD), and the Integrated Counter Measures (ICM) platform survivability effort. Project DK19 develops testable prototypes showing the operational payoff of advanced self-configuring, multiple intelligence remote sensors. By integrating this suite of advanced technologies into an operational system, it allows the Special Operations Forces and US Army to develop tactics and techniques to put the technology to use when it is fielded. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, Project Reliance, and the tri-service Reliance agreements on EW. Work in this PE is related to and fully coordinated with PE 0602270A (Electronic Warfare Technology), and various Navy and Air Force PEs in accordance with the Reliance joint planning process. Navy developments are conducted in PEs 0604755N (Ship Self Defense), 0604575N (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). The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command (CECOM), Fort

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603270A - Electronic Warfare Technology**

Monmouth, NJ.

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	16060	15359	13818	0
Appropriated Value	16169	30859	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-382	0	0	
c. Omnibus or Other Above Threshold Reductions	-59	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-50	-284	0	
Adjustments to Budget Years Since FY2001 PB	0	0	50	
Current Budget Submit (FY 2002/2003 PB )	15678	30575	13868	0

Change Summary Explanation: Funding - FY 2001 - Congressional adds were received for:  
 Shortstop to enhance and expand techniques against Category 1 fuses, mature countermeasure techniques against Category 2 fuses and design and mature antenna and battery box for man-pack version of Shortstop Electronic Protection System (+3000).  
 Multiple Intelligence Remoted Sensor System to establish and demonstrate an initial prototype capability for block one packaging of Multiple

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603270A - Electronic Warfare Technology**

Intelligence Remoted Sensor System initial operational capability with low risk/low development items(+12500).



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603270A - Electronic Warfare Technology**

PROJECT  
**K15**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
K15      ADVANCED COMM ECM DEMO	6709	5277	6584	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project improves the Army's Objective Force ability to conduct uninterrupted intelligence operations in a hostile electromagnetic environment. Recent operations have re-enforced the necessity for timely and accurate gathering and dissemination of information and intelligence. The intent of this project is to provide flexible, modern systems to achieve information dominance, protect the force, and shape the battlespace. This project investigates, researches, and demonstrates communications CM and CCM technologies to intercept, identify, locate and manipulate threat computer networks and their components. Further, it focuses on testing, evaluating, and integrating specific IO/IW components, hardware (HW), and software (SW). It also demonstrates and evaluates electronic attack products that have the ability to disrupt, deny, degrade or destroy computer networks and resident information/data. Knowledge gained will be used to assess the vulnerability of US/friendly systems to threat cyber-attack, and to develop protection capabilities. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1761 - Integrated signal intelligence (SIGINT)/moving target indicator (MTI) sensor cross-cueing and situation displays into the Common Ground Station (CGS) and All Source Analysis System (ASAS). Completed transition of operator planning tool to Guardrail.  
- Designated system architecture and began prototyping for JISR Advanced Concept Technology Demonstration (ACTD). Identified joint experiments.
- 762 - Integrated technology to provide intelligence collection, CM/CMM capabilities and alerts/warnings for tactical units to enable interception, identification, and geolocation of threat emitters in the presence of decoys, deception, and jamming.  
- Matured brassboard remotely reprogrammable payload to support close-in, pre-filtering for electronic mapping of the battlefield.  
- Assessed collection, timing allocation, and operational concept of multi-function capability through Battle Lab Distributed Interactive Simulation (DIS) experiments.
- 4186 - Demonstrated capability to mature and launch both radio frequency (RF) and wired-based attacks against Army information systems as a tool to validate protection mechanisms.  
- Performed field testing and validation of Army First Digitized Division (FDD) command and control (C2) protection systems against developed attacks.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603270A - Electronic Warfare Technology**

PROJECT

**K15**

## FY 2000 Accomplishments (Continued)

- Conducted vulnerability assessment to evaluate level of security achieved / tool suitability based on test results.
- Iteratively revised protect/attack tools to counter newly identified threats.

Total 6709

## FY 2001 Planned Program

- 1462 - Integrate wide-band conformal-antenna and specific emitter identification technology into advanced intelligence collection and CM models. Prototype in tactical software radio testbed.
  - Perform additional Battle Lab simulation experiments to further refine operational concepts, and improve signal mapping and visualization and analysis tools for Future Combat Systems (FCS).
  - Demonstrate a multi-function RF collector prototype to search for, intercept, identify and locate low-power threat emitters.
- 3707 - Provide Objective Force with information operation capability to detect and recognize threat computers and resident information.
  - Provide a stealthy information operation capability to disrupt, deny, degrade or destroy information resident in threat computers or computer networks.
  - Design and conduct distributed simulation experiments to support maturation efforts and training for integrated C2 protect and attack capabilities. Demonstrate in a field test for the digitized division. Provide results/recommendations to Program Executive Officer (PEO) Command, Control and Communications Systems (C3S) and PEO Intelligence, Electronic Warfare and Sensors (IEW&S). Jointly develop a transition and integration plan.
- 108 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5277

## FY 2002 Planned Program

- 1141 - Demonstrate the ability to protect the Army's tactical information systems by evaluating the effectiveness of attack tools against protection mechanisms in a laboratory demonstration. Validate the successful attainment of Tactical C2 Protect ATD exit criteria.
- 3393 - Demonstrate and evaluate the multi-function electronic collection and mapping system in a simulation model that reflects the FCS environment.
- 2050 - Complete tools for automated intelligence support system mission planning and military intelligence (MI) asset management tools.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603270A - Electronic Warfare Technology**

PROJECT

**K15**

**FY 2002 Planned Program (Continued)**

- Complete antenna pattern test system mission planning tools for JISR ACTD.
- Complete terrain reasoning tools for JISR ACTD.

Total 6584

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603270A - Electronic Warfare Technology**

PROJECT  
**K16**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
K16 NON-COMMO ECM TECH DEM	8969	9941	7284	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project researches and investigates the Army's Objective Force non-communications EW HW/SW CM technologies. The intent of this project is to provide Army aviation and ground vehicles with full dimensional protection using an integrated multispectral suite of precision warning sensors. It demonstrates and evaluates the feasibility and utility of these technologies to provide self-protection against optical, EO, IR and radar threats. The project will demonstrate integrated multispectral radar and IR CM to provide Army aircraft with full spectrum protection against advanced missiles and Integrated Air Defense Systems (IADS). Additionally, this project will demonstrate a "non-traditional" use of electronic combat systems to provide precision targeting, combat identification, and real time SA updates. This program supports the Objective transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 7623 - Conducted Distributed Interactive Simulations (DIS) experiments to refine integrated sensors, targeting functional modes, and operator interfaces for aviation and ground users.
  - Investigated multi-wavelength missile warning sensor technologies to provide extended range detection of missile launches, reduce false alarms, and provide sufficient signature data to discriminate anti-tank from anti-aircraft missiles.
  - Investigated laser warning technologies that can locate and discriminate between laser designators, range finders, and beamriders.
  - Identified communication links and defined variable message format (VMF) requirements to report missile launch, laser designator, laser range finder, laser beamriders and radar from aircraft to ground vehicles and command/intelligence fusion centers.
  - Investigated new instantaneous/time refined techniques to precisely locate surveillance and targeting air defense radars.
  - Investigated algorithms/software for correlating missile warning data and digital terrain elevation data to provide location missile launches.
  
- 1346 - Matured and conducted 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.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603270A - Electronic Warfare Technology**

PROJECT  
**K16**

**FY 2000 Accomplishments (Continued)**

- Matured and evaluated techniques to counter a new generation of surface-to-air and anti-tank guided munitions (ATGMs) directed against aviation.

Total 8969

**FY 2001 Planned Program**

- 8142 - Conduct DIS experiments with aviation and ground users to evaluate integrated sensors and targeting functions, then define demonstration scenarios and performance measures.
  - Complete maturation of compact, multi-wavelength missile warning sensor modules.
  - Continue maturation of data fusion software and circuit card modules that locate and identify missile launches, radars, laser designators, laser range finders and laser beamriders.
  - Complete maturation of data fusion software modules to generate SA displays and messages, and select and manage countermeasure responses based on specific threats.
  - Incrementally integrate ISAT modules into the I2WD Systems Integration Lab testbed and conduct hardware-in-the-loop simulation and testing to verify end-to-end functionality.
  - Complete maturation of precision angle of arrival (AOA) laser warning sensor.
- 1523 - Mature, integrate and test component technologies for an ICM capability.
  - Integrate and test Defense Advanced Research Projects Agency (DARPA) and Army Research Laboratory (ARL) microwave and millimeter wave power modules that will reduce transmitter weight and increase reliability and jamming power output.
- 276 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9941

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603270A - Electronic Warfare Technology**

PROJECT  
**K16**

## FY 2002 Planned Program

- 5445 - Conduct DIS to evaluate ISAT feeds into the Joint Intelligence, Surveillance and Reconnaissance (JISR) Advanced Concept Technology Demonstrations (ACTD).
  - Initiate and complete integration of ISAT hardware and software in a UH-60 (Black Hawk) test aircraft.
  - Demonstrate through flight testing the overall, ISAT compared to Exit Criteria, capability and transition the ISAT technologies.
- 1839 - Integrate and test Integrated Countermeasures (ICM) STO capabilities in a ground vehicle.
  - Field test millimeter wave electronic countermeasures (ECM), live fire top attack fuze jamming and deception of battlefield surveillance radars.

Total 7284

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603313A - Missile and Rocket Advanced Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	43991	51629	59518	0	0	0	0	0	0	0
206 MISSILE SIMULATION	2412	10346	2792	0	0	0	0	0	0	0
263 FUTURE MSL TECH INTEGR(FMTI)	19324	20680	30051	0	0	0	0	0	0	0
380 MULTI PLATFORM LAUNCHR	2122	0	0	0	0	0	0	0	0	0
493 RAPID FORCE PROJ DEMO	13018	0	0	0	0	0	0	0	0	0
550 COUNTER ACTIVE PROTECTION	1936	6902	5483	0	0	0	0	0	0	0
567 LCPK FOR 2.75 INCH ROCKETS	5179	3793	0	0	0	0	0	0	0	0
655 HYPERVELOCITY MISSILE TD	0	0	21192	0	0	0	0	0	0	0
704 ADVANCED MISSILE DEMO	0	0	0	0	0	0	0	0	0	0
713 STARSTREAK/STINGER LIVE FIRE TEST	0	9908	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This program element demonstrates advanced missile technologies to enhance weapon system lethality, survivability, agility, deployability, and affordability capabilities for the Future Combat Systems (FCS) and the Objective Force. Efforts are conducted through system simulation, design, demonstration, and test in laboratory and operational scenarios. This program element includes demonstrations of advanced tactical missiles, real-time hardware-in-the-loop simulations, and multi-role seeker technology efforts. The technologies in this PE enhance the capabilities of locating targets in clutter, lightweight missile launchers, precision guidance, and hypervelocity missile flight. The major efforts in this project are the Compact Kinetic Energy Missile (CKEM), Common Missile (CM), Low Cost Precision Kill (LCPK), NetFires and loitering attack munition-aviation (LAM-A). The CKEM technology program will demonstrate a prime candidate to provide overwhelming lethality for the FCS Direct Fire System, with increased stowed rounds. The CKEM program schedule has been aligned with the FCS schedule. The funding for this program was increased to accelerate prototype testing for insertion into the FCS demonstrator. The goal is to design, fabricate and demonstrate a direct-fire missile that offers FCS a significant increase in cost/kill ratio and enhanced stowed-kills, when compared to current direct-fire weapon systems. The NetFires funding provides for acceleration and risk reduction for the NetFires Precision Attack Missile (PAM) effort, by initiating funding for a second PAM contractor. The remaining funding for the NetFires program is in PE 0603005A as part of the overall FCS program. The LAM-A funding provides acceleration and risk reduction for development and demonstration of a long range precision strike munition for the Objective Force. This demonstration will use the loiter attack munition (LAM) being developed under the Netfires program and leverages technologies and sub systems being developed by Defense Advanced Research Projects Agency (DARPA). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan (AMP) and Project Reliance.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603313A - Missile and Rocket Advanced Technology**

The program element contains no duplication with any effort within the Military Departments. Work is performed by the Aviation and Missile Research, Development, and Engineering Center, U. S. Army Aviation and Missile Command, Redstone Arsenal, AL. Transition for this effort comes from work performed in PE 0602303A (Missile Technology).

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	51188	25107	24942	0
Appropriated Value	51639	52107	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1264	0	0	
c. Omnibus or Other Above Threshold Reductions	-195	0	0	
d. Below Threshold Reprogramming	-5933	0	0	
e. Rescissions	-256	-478	0	
Adjustments to Budget Years Since FY2001 PB	0	0	34576	
Current Budget Submit (FY 2002/2003 PB )	43991	51629	59518	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for project D263, AMCOM Technical Base (+7500), project D550, Counter Active Protection Systems (+1500), project D206, Missile Simulation Technology (+8000), and project 713, Starstreak/Stinger Live Fire Test (+1000)



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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603313A - Missile and Rocket Advanced Technology**

0).

- (+10000) Starstreak/Stinger Live Fire Test - One year congressional add to complete blast overpressure reduction validation and performance envelope expansion analysis. Complete Air-to-Air Stinger Kit (ATASK) system design and validate component performance. Continue supporting Army Test and Evaluation Command (ATEC) operational test planning. Perform system hardware and software integration and testing in the Boeing Aircraft Integration Lab (AIL) hot bench. Initiate integration of hardware and software into AH-64D testbed aircraft.

FY 2002: Funding increased to accelerate the CKEM technology effort in project D655, CKEM (+16576); added funding to accelerate loiter attack munitions for aviation effort in project D263, LAM-A (+5000) and added funding for a second PAM contractor in project D263, Netfires (+13000).

FY 2003: Funding increased to accelerate the CKEM technology effort in project D655, CKEM (+18285).

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603313A - Missile and Rocket Advanced Technology**

PROJECT  
**206**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
206 MISSILE SIMULATION	2412	10346	2792	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project supports three separate, but related, tasks. The first task is design, expansion, and improvement of hardware-in-the-loop (HWIL) simulation capabilities. The HWIL simulation is applicable to the evaluation of tactical missiles guided by signals in radio frequency (RF), millimeter wave (MMW), electro-optical (EO), and infrared (IR) electromagnetic spectral regions and multi-mode guidance technologies such as those envisioned for the Common Missile and other systems for the FCS and Objective Force. The second task is Distributed Interactive Simulation (DIS) via a node to the Defense Advanced Research Projects Agency (DARPA) Defense Simulation Internet. The third task is battlefield distributed simulation, which provides an all-analytical simulation of FCS and Objective Force weapon systems engaging multiple targets in a simulated battlefield environment, including the effects of natural and battle-caused obscurants and disturbances. Evaluation by means of HWIL provides cost-effective support to missile maturation throughout weapon system life cycles and permits a reduction in the number of flight tests actually performed. Work is performed by the Aviation and 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 CSC-Nichols Research Corporation, Huntsville, AL. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1616 - Initiated technology investigations for tri-mode HWIL simulation to support Common Missile (CM) design.
  - Implemented 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.
  - Investigated means of implementing a HWIL simulation capability for active IR and laser detection and ranging (LADAR) guidance systems.
  
- 796 - Extended battlefield test bed and Distributed Simulation Center capabilities to support Simulation Based Acquisition principles and investigated future battle-fighting techniques via live, constructive, and virtual simulations.
  - Upgraded software tools and virtual prototype applications to HLA compliance. Improved real-time computer-generated forces to support R&D requirements.

Total 2412

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603313A - Missile and Rocket Advanced Technology**

PROJECT  
**206**

**FY 2001 Planned Program**

- 1740 - Design and implement CM HWIL simulation, including, semiactive laser mode and MMW signal radiation. Initiate trichroic beam combiner technology.  
 - Develop technology components applicable to implementation of a HWIL simulation capability for active IR, such as LADAR, guidance systems.
- 591 - Upgrade distributed simulation capabilities including the Advanced Prototype and Experimentation (APEX) lab, Battlefield Highly Immersive Virtual Environment (BHIVE), classified and unclassified Ethernet and fiber optic wide area and local network equipment to sufficient bandwidth, image processing power, and recent technological advances.
- 7710 - One year congressional add for Missile Simulation Technology to develop design and build new manned simulators and virtual prototypes of future aviation and missile systems based upon battlefield highly immersive virtual environment technology (BHIVE), and system design data from collaborative environments; incorporate and demonstrate the Emissive Sources Imaging (ESI) Model with the PC based common missile class of models; develop design and build real-time emulation of emissive smoke using parallel processing techniques applied to sensor analysis.
- 305 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 10346

**FY 2002 Planned Program**

- 2094 - Support implementation of a HWIL simulation facility for CM by leveraging program management office (PMO) funds.  
 - Mature trichroic beam combiner technology for CM HWIL simulation.  
 - Further mature end-to-end HWIL simulation techniques with remotely located ground equipment (launchers, C4I, fire control sensors and units) connected to real-time HWIL missile components and simulations.
- 698 - Design and implement distributed simulation capabilities including the APEX BHIVE, classified and unclassified ethernet and fiber optic wide area and local network equipment to analyze FCS, CKEM, the Objective Force and weaponization of manned and unmanned air and ground vehicles in conjunction with Battle Labs and other Research, Development and Engineering Centers (RDEC's).  
 - Investigate parallel processing techniques to provide image processing power to enhance obscuration modeling required by both real and virtual prototype simulators.

Total 2792

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603313A - Missile and Rocket Advanced Technology**

PROJECT

**206**

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603313A - Missile and Rocket Advanced Technology</b>						PROJECT <b>263</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
263 FUTURE MSL TECH INTEGR(FMTI)	19324	20680	30051	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project demonstrates advanced tactical missile technologies including seekers, propulsion, airframes, and guidance and control for FCS and the Objective Force. The major efforts in this project are the Common Missile (CM), an effort to initiate a second PAM contractor for the NetFires programs, and acceleration of loiter attack munition-aviation (LAM-A) technologies. CM technology is the demonstration and integration of 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, and millimeter wave 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 bi-propellants 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 FY 2004 System Development and Demonstration (new 5000.2) start for CM and are supported by the Program Executive Officer Tactical Missiles. The CM technologies developed will enable the Netfires program to mature a common module family of missiles. The family of missiles will include direct fire, indirect fire, loiter attack - ground, loiter attack - aviation, air defense, and deep operations capabilities. The LAM-A effort will develop and demonstrate a long-range (60 km) precision strike munition for the Objective Force. The demonstration will use the LAM munition developed by the Netfires program and will leverage technologies and subsystem components being developed by DARPA. The full-scale system demonstrations for the air defense and deep operations will be completed in project D704. Work is performed by the Aviation and Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL. Major contractors are TRW Space Electronics Group, Redondo Beach, CA; Raytheon Systems Company, Tucson, AZ; The Boeing Company, Huntsville, AL; Northrop-Grumman Corporation, Baltimore, MD; Lockheed Martin Fire Control Division, Orlando, FL; BAE North America, Austin TX; Thiokol, Elkton, MD; Atlantic Research Corporation, Gainesville, VA; TRW Redondo Beach, CA; Boeing, Rocketdyne, Canoga Park, CA; and Alliant Tech Systems, Inc. Rocket Center, WV. This program supports the Objective Force transition path of the TCP.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603313A - Missile and Rocket Advanced Technology**

PROJECT

**263**

## FY 2000 Accomplishments

- 6076 - Downselected to best value CM tri-mode seeker concepts based on FY 1999 seeker tradeoff studies.  
- Identified alternative CM seeker that offers higher payoff and greater risk than selected primary seeker.
- 5540 - Investigated best controllable thrust propulsion both gel and pintle-solid designs for CM.  
- Investigated Automatic Target Recognition (ATR) hardware and software that best meets CM requirements.
- 7708 - Successfully performed flight test of FMTI full-up missile (Congressional Plus-up).

Total 19324

## FY 2001 Planned Program

- 8376 - Complete hardware design and begin fabrication of captive flight test seekers.  
- Conduct bench and tower test of prototype seekers.  
- Begin preparations for seeker flight test program.  
- Design and fabricate scene generator and multi-mode seeker testbed.
- 7602 - Conduct controllable propulsion trade study for CM.  
- Conduct analysis of alternative propulsion systems.  
- Conduct analysis of fuel/oxidizer chemistry to enhance performance.  
- Complete controllable thrust motor maturation.  
- Conduct static test firings of controllable thrust motor.  
- Explore ATR hardware/software for use on CM.  
- Conduct guidance datalink feasibility.
- 4109 - Investigate aircraft integration issues for the Loiter Attack Munition - Aviation (LAM-A).  
- Support the DARPA Network Fires program, to include test, analysis, and simulation to reduce overall technical risk.  
- Investigate low cost missile alternatives for soft targets.
- 593 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 20680

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603313A - Missile and Rocket Advanced Technology**

PROJECT  
**263**

**FY 2002 Planned Program**

- 7200 - Continue final seeker hardware fabrication and assembly.  
 - Conduct seeker tower testing.  
 - Prepare seekers and range for Captive Flight Testing.
- 4200 - Continue final fabrication of propulsion system hardware and static testing of flight- type hardware.
- 651 - Explore datalink and ATR implication in CM designs.
- 13000 - Initiate second PAM contractor to increase competition and encourage cost reduction for the joint DARPA/Army Netfires program. The remaining funding for this effort is provided in PE 0603003A.  
 - Provide alternate PAM concepts.  
 - Accelerate flight testing of prototype NetFires missiles.
- 5000 - Accelerate demonstration and flight testing of a full-scale LAM-A prototype.  
 - Initiate engineering design of soft launch boost motor and aircraft rail interface.  
 - Purchase long lead-time items to build prototype missiles.  
 - Develop test plans to include ballistic, controlled, and guided flight testing.

Total 30051

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603313A - Missile and Rocket Advanced Technology**      PROJECT  
**550**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
550      COUNTER ACTIVE PROTECTION	1936	6902	5483	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project will mature and demonstrate technologies, which can be applied to anti-tank guided weapons (ATGW), including chemical warhead FCS and Objective Force weapons. This technology will improve the effectiveness of ATGW against threat armor equipped with active protection systems (APS). Current technology development is concentrated in the following areas; electronic warfare (EW) radio frequency (RF) countermeasure (RFCM) technology that jams or deceives the radar sensors of threat APS, and warhead integration to fire the missile warhead before being destroyed by the APS. Work is performed by the Aviation and Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, Alabama; Phase IV Systems, Inc, Huntsville, AL. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

- 1936      - Completed first iteration monolithic microwave integrated circuit (MMIC) component maturation for third generation RF countermeasure.
- Began design and fabrication of brassboard activity detector, first iteration antennas, and brassboard base band module.

Total    1936

**FY 2001 Planned Program**

- 5402      - Complete brassboards of activity detector, first iteration antennas, and brassboard base band module.
- Complete brassboard RF transceiver module using first iteration MMICs.
- Complete functional demonstration of third generation RFCM using brassboard modules and components.
- Complete second iteration MMIC component development.
- Begin design and fabrication of third generation RF test bed.
- Begin integration to missile test bed airframes.



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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603313A - Missile and Rocket Advanced Technology**

PROJECT

**550**

## FY 2001 Planned Program (Continued)

- 1312 - One year congressional add for Counter Active Protection Systems to design and fabricate additional MMIC components for the RF transceiver module and upgrade RF test bed.
  - 188 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 6902

## FY 2002 Planned Program

- 5483 - Complete third iteration MMIC component maturation.
    - Complete third generation RF test bed.
    - Complete final RF transceiver module prototype.
    - Complete full performance and functional demonstration of third generation RFCM prototype in dynamic test against APS second and third generation RF test beds.
    - Begin fabrication of twelve third generation RFCM flight prototypes.
- Total 5483

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603313A - Missile and Rocket Advanced Technology** PROJECT  
**655**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
655      HYPERVELOCITY MISSILE TD	0	0	21192	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** Compact Kinetic Energy Missile (CKEM) will enable the Objective Force and the Future Combat Systems by providing overwhelming lethality with a small, light, fast hypervelocity compact kinetic energy missile. CKEM will develop and demonstrate advanced hypervelocity missile technology necessary for the next generation kinetic energy weapon applicable to Future Combat Systems (FCS). CKEM will demonstrate enhanced system lethality with 4 foot long, 50-lb. objective hypervelocity kinetic energy (KE) missile. Miniature guidance inertial measurement unit (IMU) technology will demonstrate high-g missile launch, independent of launcher attitude and provide precision kill at target impact ranges of 0.4-5 km. The program will develop, mature, and demonstrate advanced component and subsystem and system level technologies in a missile system configuration to achieve next-generation system level performance. Major contractors are Lockheed Martin, Dallas, TX; MILTEC/Boeing, Huntsville, AL; and Raytheon Company, Tucson, AZ. This program supports the Objective Force transition path of the TCP.

**FY 2000 Accomplishments**

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)

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603313A - Missile and Rocket Advanced Technology**

PROJECT

**655**

## FY 2002 Planned Program

- 4699 - Incorporate the results of the technology and component maturation efforts (in PE 0602303A, Missile Technology) and ensure compatibility with FCS and other Objective Force platform development efforts.
  - Incorporate the technology matured under PE 0602303A, Missile Technology, into a flight worthy component and demonstrate that the component meets the defined form, performance, interface and flight environmental requirements.
- 16493 - Mature and validate critical component performance through subsystems and system integration and tests, leading to missile flight tests. Conduct critical issue and risk assessment phase of the system contract efforts with two prime contractors.
  - Validate high fidelity system simulation through hardware-in-the-loop of propulsion unit, guidance system, and hypervelocity aero-ballistic models.
  - Demonstrate enhanced lethality in system configuration to include novel penetrators for missile applications and quantification of lethality effects other than perforation.
  - Incorporate hypervelocity technology into integrated tactical system concepts whose design has been demonstrated to meet the system performance, interface and flight environment requirements.

Total 21192

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603606A - Landmine Warfare and Barrier Advanced Technology</b>							
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	45918	20702	23062	0	0	0	0	0	0	0
608 COUNTERMINE & BAR DEV	26864	18083	20114	0	0	0	0	0	0	0
683 ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES	19054	2619	2948	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) matures and demonstrates robust countermining technologies for the Army's Transformation to the Objective Force. Operations in Bosnia and Kosovo have shown the need for better ways to detect and neutralize land mines. High priority countermining requirements include in-stride detection and breaching, close-in detection, area clearance and neutralization of landmines. This PE funds remote detection of minefields, and individual mine detection from handheld, ground and aerial sensor systems. Envisioned mines include both metallic and low/non-metallic construction. The use of wide-area multi-sensor fusion detection systems, coupled with small-area confirmation sensors, will be emphasized to increase Operational Tempo (OPTEMPO) of the Objective Force. This multi-sensor approach has the potential to yield high probability of mine detection at very low false alarm rates. Airborne multispectral/hyperspectral mine detectors will be assessed for contingency applications and matured for lightweight plug-and-play use in mission specific applications. The expectation is robust approaches to finding surface-laid and buried mines in varying vegetation, soil and diurnal conditions. Alternative systems for anti-personnel (AP) landmines and innovative concepts for minefield clearance also will be explored. Advanced Technology Demonstration (ATD), Advanced Warfighting Experiments (AWE), and modeling and simulation activities will be performed to assess effectiveness of technical and system concepts. Efforts within this PE are closely coordinated with the Marine Corps. The work in this program follows the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. It also adheres to Tri-Service/Project Reliance Agreements on conventional air/surface weapons and ground vehicles. This PE contains no duplication with any other effort with the Army, or DoD. It also is fully coordinated with PE 0603619A (Landmine Warfare and Barrier Advanced Development), PE 0602712A (Countermining Systems) and PE 0602709A (Night Vision Technology). This PE is managed by the Night Vision Electronic Sensors Directorate (NVESD), Communications-Electronics Research, Development and Engineering Center (CERDEC).

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603606A - Landmine Warfare and Barrier Advanced  
 Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	47117	20894	22976	0
Appropriated Value	47456	20894	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1199	0	0	
c. Omnibus or Other Above Threshold Reductions	-184	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-155	-192	0	
Adjustments to Budget Years Since FY2001 PB	0	0	86	
Current Budget Submit (FY 2002/2003 PB )	45918	20702	23062	0

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603606A - Landmine Warfare and Barrier  
Advanced Technology**

PROJECT  
**608**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
608 COUNTERMINE & BAR DEV	26864	18083	20114	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures countermine technologies for integration into the Future Combat Systems (FCS) and other uses in the Objective Force. Specific activities include remote detection of minefields, and individual mine detection from handheld, ground and aerial sensor systems. Envisioned mines include both metallic and low/non-metallic construction. Wide-area multi-sensor fusion detection systems, coupled with small-area confirmation sensors, will be evaluated in their potential to yield high probability of mine detection at very low false alarm rates. The intent is to increase the OPTEMPO of the Objective Force. Airborne multispectral/hyperspectral mine detectors will be assessed for contingency applications and matured for lightweight plug-and-play use in mission specific applications. The expectation is robust approaches to finding surface-laid and buried mines in varying vegetation, soil and diurnal conditions. The project will provide soldier-portable, countermine capabilities to the dismounted combat engineer by adapting commercial, or emerging Defense Advanced Research Projects Agency (DARPA) technologies. Envisioned technology areas include robotics, infrared and visual imagery, acoustics, signal processing, electronic and physical mine marking, and telemetry. The intent is to provide enhanced Situational Awareness (SA) to infantry and other dismounted forces prior to their entry into the enemy/obstacle range of engagement. These efforts support ATDs, AWE, and modeling and simulation assessments, defining potential system effectiveness the Objective Force. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 9262 - Evaluated Mine Hunter/Killer integration of close-in mine detection and neutralization capabilities which dramatically improve the rate at which maneuver/transport lanes are cleared through mine fields.
  - Evaluated teleoperation capability of Mine Hunter/Killer for on-route missions.
  - Evaluated downselected precision neutralization technology against surface and buried anti-tank (AT) mines in various soils, overburden and environmental conditions and demonstrated greater than a 90% probability of kill for neutralization.
  - Completed Mine Hunter/Killer demonstration and transitioned mine neutralization technology and neutralization placement techniques to the Ground Standoff Mine Detection System (GSTAMIDS) acquisition program.
- 14153 - Completed design trade studies and initiated detailed design of a filter wheel modification for the advanced Tactical Unmanned Aerial Vehicle (TUAV) electro-optic/infrared (EO/IR) sensor.
  - Applied and matured minefield detection Aided Target Recognition (ATR) algorithms for multispectral sensors.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603606A - Landmine Warfare and Barrier  
Advanced Technology**

PROJECT

**608**

## FY 2000 Accomplishments (Continued)

- Performed ground and airborne data collections against buried and surface emplaced mines using multiple sensors that provided data to support phenomenology investigations and multispectral ATR algorithm selection and development.
- Matured system and component requirements/specifications and conducted an evaluation of a lightweight multispectral (laser polarization and long wave infrared) detection sensor optimized for surface minefield detection. Sensor weight will be compatible with future tactical/short range UAVs and capable of performing in a broad range of environments.
- 882 - Analyzed data from Joint Countermine (JCM) Advanced Concept Technology Demonstration (ACTD) demo II and applied lessons learned to detection and area clearance technology programs.
- Provided support for JCM command, control, communications, computers and intelligence (C4I) transition efforts.
- 2567 - Planned a Joint Area Clearance (JAC) effort to evaluate mine clearance techniques and prototypes for tactical use and proposed effort as an ACTD.
- Matured mission scenarios for Warfighter Exercises where various mine clearance prototypes will be evaluated for effectiveness.
- Identified mine clearance components and developed assessment strategies.

Total 26864

## FY 2001 Planned Program

- 3451 - Evaluate scanning quadrupole resonance (QR) and advanced mine detection sensors (AMDS) technologies to assess performance for vehicle mounted mine detection applications in the Objective Force.
- Establish initial confirmation sensor technical benchmark.
- 13916 - Complete detailed design of filter wheel modification, fabricate modified sensor and perform initial airborne tests of the modified advanced TUAV EO/IR sensor against surrogate minefields.
- Complete detailed design and initiate fabrication of a prototype lightweight multispectral (laser polarization and long wavelength infrared) detection sensor.
- Complete maturation and evaluation of advanced minefield detection algorithms and enhance methods of airborne detection of buried and surface emplaced mines (increase probabilities of detection and reduce false detection rates).
- Evolve and design a test and evaluation strategy that will fully measure the ability of lightweight multi/hyperspectral technology to achieve the Army's airborne minefield detection requirements.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603606A - Landmine Warfare and Barrier  
Advanced Technology**

PROJECT

**608**

## FY 2001 Planned Program (Continued)

- 264 - Finalize JAC ACTD planning.  
- Establish user operational concept and perform component evaluation.  
- Conduct initial Warfighter Exercises to evaluate mine clearance prototypes.
- 452 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 18083

## FY 2002 Planned Program

- 6245 - Investigate integration of scanning quadrupole resonance mine detection technology onto a vehicle platform.  
- Evaluate QR prototype and mature advanced electromagnetic technologies for mine target detection.
- 3046 - Evaluate mine clearance prototypes in focused JAC exercises with Marine Corps and Army user representatives and prepare interim military assessment of JAC capabilities.
- 1859 - Assess explosive detection chemical sensors, advanced electromagnetic techniques, and novel ground penetrating radars for use on small mobile robots for dismounted mine detection operations.
- 8964 - Complete field performance evaluation of the modified advanced TUAV EO/IR minefield detection sensor and aided target detection software suite.  
  
- Assemble and integrate prototype lightweight multispectral (laser polarization and long wavelength infrared (LWIR)) minefield detection sensor and initiate system testing.

Total 20114



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603606A - Landmine Warfare and Barrier  
Advanced Technology**

PROJECT  
**683**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
683 ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES	19054	2619	2948	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project provides Advanced Technology Demonstrations (ATDs) supporting an Objective Force capability for alternative systems for anti-personnel landmines (APLs) that minimize the risks to non-combatants. This includes alternatives to anti-personnel submunitions used in mixed anti-tank (AT) landmine systems and possibly to the entire mixed landmine systems themselves. The alternative systems will include surveillance systems, command and control systems, and overwatch fires which will be evaluated and matured 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 program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 8530 - Developed and evaluated alternative concepts through exploration studies.  
- Established independent study groups from National Academy of Science and Department of Defense National Laboratories.
- 8524 - Developed components and prototypes to support alternative studies.
- 2000 - Investigated the utility of a new generation of micro-sensors, communications and non-lethal munitions components and subsystems for mid-term mixed landmine alternatives.

Total 19054

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603606A - Landmine Warfare and Barrier  
Advanced Technology**

PROJECT

**683**

## FY 2001 Planned Program

- 2542 - Modify new generation of expendable day/night imaging sensors, communications devices, low cost point detectors and deterrent devices (lethal and non-lethal munitions) for force protection and landmine alternative roles.
  - Test and evaluate advanced technology brassboards for landmine alternatives concept development.
- 77 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2619

## FY 2002 Planned Program

- 2948 - Investigate mobility of an adaptable network of expendable sensors and new deterrent devices to meet landmine alternatives requirements and Future Combat Systems (FCS) protection roles.
  - Test mobility concepts of adaptable network sensors and deterrent devices for landmine alternative missions.

Total 2948

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603607A - Joint Service Small Arms Program (JSSAP)</b>					PROJECT <b>627</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
627 JT SVC SA PROG (JSSAP)	8539	4428	5828	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) matures and demonstrates advanced technologies that integrate into individual and crew-served weapons with greater lethality, utility and range at a significantly reduced weight that will enable the Army Transformation to the Objective Force. Efforts include: the Objective Crew-Served Weapon (OCSW) Advanced Technology Demonstration (ATD) and Objective Individual Combat Weapon (OICW) System Enhancement. OCSW demonstrates the next generation crew-served weapon with improved combat effectiveness such as being able to hit protected personnel targets in defilade (obscured or non-visible), with a reduced weight of 65-75% over M2 machine guns, MK19 grenade machine guns and M240 machine guns. The system enhancement efforts will develop, demonstrate and transition lethality enhancing and cost reducing technologies into the OCSW and OICW. All Joint Service Small Arms Program (JSSAP) efforts follow the Joint Service Small Arms Master Plan (JSSAMP) and Service Mission Need Statements and Operational Requirement Documents. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the US Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is derived and fully integrated with the 6.2 efforts found in PE 0602623A (Joint Service Small Arms Program) and PE 0602624A (Weapons and Munitions Technology). Transition paths have been established in coordination with Product Manager (PM) Small Arms; USMC Director, Ground Weapons; and US Special Operations Command (SOCOM). This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1163 Completed OCSW system design refinements of a lightweight (less than 50 lb.) weapon (gun, pintle, traverse and elevation, and tripod).
- 1251 Conducted weapon/mount reliability and durability testing; established OCSW interface with Land Warrior and demonstrated functionality.
- 2272 Completed manufacture and test of OCSW fire control system.
- 3853 Completed build of first OCSW weapon; conducted subcomponent integration of OCSW fire control; demonstrated OCSW fuze setting in rapid-fire (3-5 round burst mode).

Total 8539

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

June 2001

**BUDGET ACTIVITY**  
**3 - ADV TECHNOLOGY DEV**

**PE NUMBER AND TITLE**  
**0603607A - Joint Service Small Arms Program**  
**(JSSAP)**

**PROJECT**  
**627**

**FY 2001 Planned Program**

- 2754 Conduct 1000-2000 meter firing tests with full solution fire control of OCSW launched, high explosive, airburst munition; test and evaluate integrated OCSW weapon/fire control system; conduct ruggedness and environmental testing; complete planning of OCSW safety release testing; fabricate and test initial system hardware; build ATD small arms simulator and conduct OCSW virtual simulations.
  - 1555 Conduct initial system level demonstration of integrated OCSW (weapon/ammunition/fuze/fire control); complete build of follow-on OCSW system in preparation for ATD FY 2002.
  - 119 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 4428

**FY 2002 Planned Program**

- 1807 Fabricate OCSW ATD munitions (Target Practice, Target Practice-Spotter, High Explosive); complete fabrication of OCSW ATD fuzes; complete OCSW transition activities and complete ATD; conduct OCSW Milestone I Decision Review.
  - 4021 OICW System Enhancement: Update initial designs, fabricate test hardware, and evaluate in inert warheads the performance of micro-electro-mechanical systems (MEMS) based safe and arming (S&A) mechanism employing Micro Energetic Initiation (MEI). MEI provides a 75% volume/50% cost reduction in the fuze S&A.
- Total 5828

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	8760	4469	5804	0
Appropriated Value	8869	4469	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR/STTR Program	-221	0	0	0
c. Omnibus or Other Above Threshold Reductions	-34	0	0	0
d. Below Threshold Reprogramming	0	0	0	0
e. Rescissions	-75	-41	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	24	0
Current Budget Submit (FY 2002/2003 PB )	8539	4428	5828	0

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603607A - Joint Service Small Arms Program  
(JSSAP)**

PROJECT

**627**

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603654A - Line-of-Sight Technology Demo</b>					PROJECT <b>460</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
460 LOSAT TECHNOLOGY DEMO	37326	50262	57384	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

Project D460-LOSAT Technology Demonstration: Line-of-Sight Anti-Tank (LOSAT) and the Kinetic Energy Missile (KEM) technology provide the foundation for the Objective Force. This program focuses on the integration of the LOSAT weapon system into an air-mobile configuration in order to help remedy the early entry force 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 highly mobile, near-term, advanced capability for overwhelming armor destruction with a high rate of fire, increased range, and increased force survivability. LOSAT, deployed in the early entry force, will provide the decisive edge to win swiftly with minimum casualties and provides an assault support weapon capability. LOSAT is strategically and tactically deployable, giving Commanders and decision makers greater flexibility. The performance of this hypervelocity kinetic energy missile (velocity of a mile per second) is not affected by the proliferation of emerging threat active protective systems and enhanced reactive armors which are both rapidly becoming available on the global marketplace. LOSAT was initiated as a DoD-approved Advanced Concept Technology Demonstration (ACTD) program in FY 1998 to position the technology for future acquisition decisions; demonstrate subsystem capabilities in flight tests and dirty battlefield environments; evaluate the utility of the LOSAT technology for the early entry forces; demonstrate an integrated HMMWV-based LOSAT system in-flight tests and advanced warfighting experiments; and evaluate affordability issues. The ACTD program is a cost-effective means to assess the operational value of LOSAT to the early entry force through deployment with the XVIII Airborne Corps while longer-term applied research efforts continue for a small Compact Kinetic Energy Missile and an objective Future Combat System. The work in this program element is consistent with the Army Science and Technology Master Plan, and the Army Modernization Plan. In December 1999, the Army and OSD, funded the LOSAT accelerated advanced development (in PE 0604819A) and procurement as part of the New Army Vision/Transformation by adding additional design activities, reducing risk, completing system qualification testing, and adding additional Operational tests to support transition to limited production of the LOSAT Weapon System, with production funds starting in FY 2004. This system supports the Legacy to Objective transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1100 - Completed Fire Unit exterior structural design for Risk Reduction Flight test.
- 675 - Initiated Fabrication of Fire Unit structural prototype for use in Risk Reduction Flight test.
- 27966 - Continued Fire Unit electronic and interior preliminary designs (including major subcontractors).
- 725 - Continued Fire Unit software requirements analysis.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603654A - Line-of-Sight Technology Demo**

PROJECT

**460**

## **FY 2000 Accomplishments (Continued)**

- 265 - Supported Dismounted Battlespace Battle Lab Early Soldier Involvement exercises.
- 475 - Continued Virtual Prototype Simulator Upgrade.
- 6120 - Continued Missile electronic and mechanical preliminary designs (including subcontractors).

Total 37326

## **FY 2001 Planned Program**

- 517 - Complete fabrication of one Fire Unit structural prototype for Risk Reduction Flight test.
- 2067 - Complete fabrication of missile hardware for two Risk Reduction Flight tests.
- 2280 - Conduct two Risk Reduction Flight tests.
- 30930 - Fire Unit electronic and interior mechanical detail designs; and initiate fabrication (including major subcontractors).
- 9816 - Missile electronic and mechanical detail designs; and initiate fabrication (including major subcontractors).
- 432 - Continue tooling design and initiate fabrication.
- 1345 - Complete Fire Unit Software requirements analysis; initiate design, code, and test.
- 500 - Support Dismounted Battlespace Battle Lab Early Soldier Involvement exercises.
- 2375 - Continue test equipment design, initiate fabrication.

Total 50262

## **FY 2002 Planned Program**

- 29957 - Complete Fire Unit detail designs; continue fabrication, assembly and test of twelve prototypes.
- 19345 - Complete Missile detail designs; continue fabrication, assembly and test 37 prototypes.
- 1646 - Complete tool design and fabrication.
- 1130 - Complete Virtual Prototype Simulator Upgrade.
- 1130 - Complete Training Device designs; initiate fabrication.
- 896 - Support Early Soldier involvement training, and planning for ACTD Company in 82nd Airborne Division.
- 2780 - Complete Fire Unit software design, code and test; initiate system level test.
- 500 - Complete Missile Software update design, code, and unit level test; initiate system level test.

Total 57384

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603654A - Line-of-Sight Technology Demo**

PROJECT  
**460**

<b><u>B. Program Change Summary</u></b>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	37845	50727	57127	0
Appropriated Value	38000	50727	0	0
Adjustments to Appropriated Value	0	0	0	0
a. Congressional General Reductions	0	0	0	0
b. SBIR / STTR	-1019	0	0	0
c. Omnibus or Other Above Threshold Reduction	-155	0	0	0
d. Below Threshold Reprogramming	500	0	0	0
e. Rescissions	0	-465	0	0
Adjustments to Budget Years Since FY2001 PB	0	0	257	0
Current Budget Submit (FY 2002/2003 PB )	37326	50262	57384	0



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603710A - Night Vision Advanced Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	38613	42746	37081	0	0	0	0	0	0	0
C65 DC65	2318	2338	2870	0	0	0	0	0	0	0
C67 DC67	3051	6252	9184	0	0	0	0	0	0	0
K70 NIGHT VISION ADV TECH	18053	22113	20428	0	0	0	0	0	0	0
K86 NIGHT VISION, ABN SYS	15191	12043	4599	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) matures and demonstrates tactical night vision and electronic sensor technologies to improve the Objective Force ability to operate in, and own the dark. Technologies and applications under this PE focus on reconnaissance, surveillance and target acquisition (RSTA), air defense, and air/ground mobility. The goal is to increase survivability by providing capabilities to acquire, engage, and destroy targets at longer ranges in complex environments and conditions (e.g. day/night, obscured, smoke, bad weather). Multispectral and hyperspectral sensors will provide the capability to detect obscured, concealed, and reduced signature threats. Multi-sensor TA suites will provide rapid, automatic, TA, and generate battlefield information/data. Improved seamless interfaces to command, control, communications, computers, and intelligence (C4I) systems and networks will support the dissemination of information. Enhanced wide field-of-view (FOV) sensor technology will support dismounted, as well as air operations (e.g. nap-of-the-earth). Advance tactical reconnaissance and surveillance technologies will provide real-time/near-real-time capabilities for imagery intelligence (IMINT), and measurement and signature intelligence (MASINT) applications. Technology advances achieved under this PE have Tri-Service applications. Work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan. It adheres to Tri-Service Reliance agreements on sensors and electronic devices, with oversight, and coordination provided by the Joint Directors of Laboratories. This PE contains no duplication with any effort within the Military Departments, and is related to, and fully coordinated with, efforts in PE 0602709A (Night Vision and Electro-Optics Technology), PE 0602270A (Electronic Warfare Technology), PE 0603774A (Night Vision Systems Advanced Development), and PE 0604710A (Night Vision Systems Engineering Development). Work in this PE is managed by the US Army Communications-Electronics Research, Development and Engineering Center (CDERDEC), Fort 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, MA; EOIR, Spotsylvania, VA; Booz-Allen, McLean, VA; Omar McCall, Beltsville, MD; ThermoTrex Corporation; Nytech, Irvine, CA; Indigo, Santa Barbara, CA; Wescam, Sonoma, CA; and Mitex, San Antonio, TX.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603710A - Night Vision Advanced Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	42262	33341	37741	0
Appropriated Value	42628	43141	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1049	0	0	
c. Omnibus or Other Above Threshold Reductions	-161	0	0	
d. Below Threshold Reprogramming	-2600	0	0	
e. Rescissions	-205	-395	0	
Adjustments to Budget Years Since FY2001 PB	0	0	-660	
Current Budget Submit (FY 2002/2003 PB )	38613	42746	37081	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for Helmet Mounted infrared (IR) Sensor Development (+3800) and Backpack Unmanned Aerial Vehicle (UAV) (+6000).  
 - (+3800) Matures a Helmet Mounted IR Sensor System which will significantly improve situational awareness (SA) in smoke filled environments, as well as for search and rescue missions.  
 - (+6000) For maturation and evaluation of a Backpack UAV to enhance the SA of the Objective Force.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603710A - Night Vision Advanced Technology**

PROJECT  
**K70**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
K70 NIGHT VISION ADV TECH	18053	22113	20428	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures and demonstrates high-performance sensor/multi-sensor technologies to increase target detection, extend target identification range, and reduce TA timelines. It supports the Objective Force and Future Combat Systems (FCS) scout, fire support, and air defense missions. The intent is to provide ground combat and amphibious assault vehicles with affordable compact sensor options for wide-area, long range, non-cooperative TA, and air defense. The Multi-Function Staring Sensor Suite (MFS3) Advanced Technology Demonstration (ATD) will demonstrate applications of a modular, reconfigurable sensor suite integrating advanced, broadband, staring infrared (IR) sensor technologies, with eye safe laser, and acoustic technologies. This project will mature a next generation, hardened, militarized, low power, and advanced, uncooled IR sensor with applications for the Thermal Weapons Sights (TWS), Objective Crew Served Weapon (OCSW), and the Objective Individual Combat Weapon (OICW). Additionally, this project supports the Cost Effective Targeting Systems (CETS) by demonstrating combinations of advanced, uncooled forward looking IR (FLIR), short wave IR (SWIR), and laser rangefinder/illuminator technologies. Other efforts include a commander's head-tracked sensor suite, to provide increased mobility, and 360 degrees SA, to commanders/squad leaders during closed hatch vehicle operations. It also provides connectivity during dismounted infantry operations in both open and complex terrain. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 13095 - Fabricated signal processing backplane, and sensor gimbal and stabilization assembly required to implement panoramic search capability.
  - Fabricated the MFS3 broadband staring thermal imaging sensor to satisfy the objective surveillance and target acquisition requirements of future scout, fire support, and air defense systems.
  - Transitioned performance and engineering data to support the FCS/Objective Force affordability in-process review.
  - Conducted MFS3 data collections, using surrogate thermal imaging sensor, to support training of the Automatic Target Recognition (ATR) software needed for high probability of detection/recognition, wide-area search modes.
- 3021 - Completed performance and design requirements, system concept modeling and field experimentation for a modular sensor incorporating improved IR technology, and smart power management architecture. Provided improved performance and reduced weight and power burden.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603710A - Night Vision Advanced Technology**

PROJECT

**K70**

## FY 2000 Accomplishments (Continued)

- Conducted system design analysis, and field data collection, of cost effective targeting system. The system provided multi-sensor alternatives and flash laser illumination for target identification.
- Defined focal plane, image processing, and image stabilization requirements for multiple sensor applications. Included TWS, OCSW, OICW, and future CETS.
- Specified power management architecture, and low power electronics to reduce power consumption. Achieved a level such that a 72-hour operational mission can be executed using one primary battery.
- 1937 -This Congressional special interest effort fabricated fire fighting, and damage control systems. Systems included helmet mounted IR camera, power supply, image projection device, transmitter/receiver, and computer, with interface and software to support voice activated system control.

Total 18053

## FY 2001 Planned Program

- 13967 - Complete MFS3 system operational mode simulation with Mounted Maneuver Battlelab to optimize user interface.
- Conduct user demonstrations and evaluations of manually operated, 3 FOV, broadband and mid-wave sensors. Characterize target recognition and identification performance. Specific emphasis placed on demonstrating utility of the ultra narrow FOV for long range target identification.
- Integrate eyesafe laser rangefinder hardware into the MFS3.
- Complete development of ATR algorithm hardware/software (multispectral detection, moving target indication, and mid wave spatial detection/recognition). Integrate into the MFS3.
- 3893 - Militarize a 640x480, uncooled, focal plane array (FPA) with increased sensitivity to enable man-portable, long range applications.
- Complete design of low power electronics and power management. Reduce power consumption by 60% compared to currently fielded systems such as the TWS.
- Complete design of lightweight optics, electronic, and mechanical interfaces to enable low power, uncooled IR sensor technology to be readily reconfigured for applications, such as the individual soldier TWS or OCSW.
- Complete performance and design requirements and system concept modeling for the CETS.
- Perform data collection with long wave IR and SWIR sensors to support ATR algorithm development for unmanned ground vehicle (UGV) applications.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603710A - Night Vision Advanced Technology**

PROJECT

**K70**

## FY 2001 Planned Program (Continued)

- Conduct field tests. Demonstrate the laser illumination viewing and ranging (LIVAR) system to the Dismounted Battlespace Battle Lab.

- 3653 - Complete Congressional special interest effort for fire fighting and damage control systems.  
- Demonstrate and conduct user evaluations of fire fighting and damage control systems, with military and civilian forces.
- 600 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 22113

## FY 2002 Planned Program

- 7800 - Use man-in-the-loop simulation, and field experimentation, to determine optimal mix of unattended sensors for early warning of local threat to Objective Force operations.  
- Integrate sensor information from suite of surrogate mini-unmanned air vehicle (UAV), UGV and unattended ground sensors to provide instantaneous information of local surrounding and hostile locations.  
- Construct planning tools to maximize deployment of unattended sensor systems based on current SA data provided from higher level intelligence assets.  
  
- Complete preliminary design for CETS. Incorporate advanced, uncooled FLIR, SWIR and microlaser technologies to produce an affordable targeting approach for mid-tier ground platforms.  
- Design sensor components, optics, and stabilized gimbal assembly to meet Sensors for the Objective Force CETS cost goals.  
- Perform data collection with latest sensor configurations for ATR algorithm development. Design processing architecture for UGV platform implementation.
- 3975 - Conduct demonstration of wide area, automatic target detection/recognition algorithm using multispectral sensor suite.  
- Complete hardware and algorithm development of acoustic sensors. Demonstrate the performance.
- 6020 - Demonstrate imagery technology through laboratory characterization, and data collection, with prototype, high pixel density, thermal imaging module.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603710A - Night Vision Advanced Technology**

PROJECT  
**K70**

## FY 2002 Planned Program (Continued)

- 1783 - Establish performance and design requirements, system interoperability, and system modeling / simulation specifications for a head tracked SA sensor suite. Incorporates state of the art thermal imaging, image intensifier, fusion, and laser technologies for closed hatch operations to increase SA, and performance. Minimize workload to the operator.
  - Perform simulation of the distributed aperture and gimbal mounted technologies of the head tracked system. Insert into the Objective Force demonstration.
  - Complete design of the head-tracked breadboard.
- 850 - Construct architecture for sensor integration, access, and management schema (SIAMS) to enable seamless access to tactical sensor data from Army and joint C4I systems using joint intelligence, surveillance, and reconnaissance (JISR) information agent technology.
  - Provide sensor simulations to support development of JISR information agent software and warfighter simulation exercises.

Total 20428

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603710A - Night Vision Advanced Technology**

PROJECT  
**K86**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
K86 NIGHT VISION, ABN SYS	15191	12043	4599	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures, and demonstrates intelligence, surveillance, and reconnaissance (ISR), targeting, and pilotage technologies in support of the Army's Objective Force airborne platforms. The goal is to significantly increase Army aviation survivability during nap-of-the-earth flights, day/night operations, and operations under adverse weather conditions. Specifically, the technology efforts focus on improved night pilotage sensors, high-resolution heads-up displays (HUD), sensor fusion, and ATR capabilities for current and future helicopters (attack, scout, cargo, and utility). Additionally, this project will enhance distributed ground sensor networks by maturing a mini-class UAV platform. Technologies will address automated flight control, and ultra-light payloads. The ALERT ATD will demonstrate an on-the-move search, using a FLIR/laser sensor suite. The aviators night vision goggles (ANVG) ATD demonstrates a lightweight FOV (20 x 100 degrees), low cost, and panoramic night pilotage capability for the air warrior. The Multi-mission UAV sensor ATD will demonstrate an affordable, high performance EO/IR payload, for transition to Program Manager (PM), Tactical UAV /PM, Night Vision Reconnaissance, Surveillance and TA (PM TUAV/PM NVRSTA). Technologies matured under this project are also applicable to night flying requirements of the other Services and the Special Operations Command's rotary wing aircraft. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 2155 - Conducted initial maturation efforts under the ANVG program. Demonstrated high resolution, wide FOV, helmet mounted sensor.
  - Conducted horizontal technology insertion (HTI) sensor/system approach for both aviation and infantry application. Provided improved performance for pilotage, driving and dismounted operations under darkness/obscurant battlefield conditions. Identified HTI design tradeoffs.
  - Performed human interface study for aviation and infantry applications.
  - Matured image intensification tube enhancements for improved performance.
- 4991 - Completed maturation and fabrication of high performance staring electro-optic (EO)/IR modular sensor payload. Designed multi-spectral capability for mine detection applications.
  - Completed environmental testing (e.g. shock, vibration, temperature, altitude, etc.) to ensure the EO/IR UAV payloads are ready for aircraft integration and flight tests.
  - Conducted test and analysis of mechanical/electrical interfaces, and core components, for rapid and simple "plug in/plug out" modularity, in support of the tactical-UAV "plug and play" selection process.

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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603710A - Night Vision Advanced Technology**

PROJECT

**K86**

## FY 2000 Accomplishments (Continued)

- 4184 - Demonstrated FLIR performance upgrade. Performed image data collections for algorithm enhancements.  
- Completed coding of algorithm modifications to achieve enhanced detection, and classification performance, against stationary and moving targets.
- 2896 - This one year Congressional special interest project matured, and demonstrated, a wire detection, and obstacle avoidance system.
- 965 - This Congressional special interest project matured a prototype mini- UAV platform with Government Furnished Equipment (GFE) sensor, launch system, ground station capability, and automated flight control.

Total 15191

## FY 2001 Planned Program

- 1480 - Fabricate sensor mockups for cockpit/equipment integration evaluations of the ANVG.  
- Complete critical design, and initiate fabrication of air warrior version of ANVG sensor package.
- 1925 - Integrate multi-mission UAV sensors on manned platform. Conduct instrumented flight-testing under dynamic flight conditions. Verify functionality of the payloads, and down links.  
- Integrate high performance EO/IR, and multi/hyperspectral sensor payloads on tactical UAV/manned reconnaissance platforms. Conduct operational demonstration, and user warfighting experiments to support military assessments.  
- Mature and transition performance and technical design data to PM NVRSTA and PM TUAV. Support final development of operational requirements and engineering specifications for TUAV Block 2 procurement.
- 2560 - Complete integration of air/land enhanced reconnaissance, and targeting technologies with demonstration aircraft. Conduct airborne flight evaluations to demonstrate increased operational benefits derived from laser and ATR algorithm enhancements when performing search on-the-move, acquiring targets in defilade, obscured, or at extended range.  
- Integrate multi-function laser with EO target acquisition sensor onto aircraft platform. Conduct performance demonstration and data collection.  
  
- Demonstrate rapid target insertion / algorithm training process to achieve automatic detection and cueing against new/emerging target threats.  
  
- Mature, and transition, performance and technical design data to support technology insertions decision by PEO Aviation platform managers (Comanche and Apache).



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

June 2001

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603710A - Night Vision Advanced Technology**

PROJECT

**K86**

## FY 2001 Planned Program (Continued)

- Demonstrate and evaluate candidate FCS high performance on-board sensor combination.
- 5768 - Complete design and fabrication of man-portable UAV and sensors for congressional interest effort. Conduct demonstration.
- 310 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 12043

## FY 2002 Planned Program

- 3751 - Conduct initial development, and integration, of FLIR with ANVG for ground applications.
  - Conduct flight test and evaluation of air version of ANVG (air version).
- 848 - Implement SIAMS architecture in a simulation environment. Demonstrate capability to access, and query platform sensor data from Army, and joint C4I systems.
  - Document SIAMS protocol, database management, and interface specifications.
  - Integrate and demonstrate SIAMS in the improved remotely emplaced battlefield acoustic, seismic, sensor (IREMBASS) and firefinder radar.
  - Provide improved resolution sensor simulations to support development of JISR information agent software. Support JISR demonstration and evaluation in warfighter simulation exercises.

Total 4599

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603728A - Environmental Quality Technology Demo**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	1291	11013	4826	0	0	0	0	0	0	0
002 ENVIRONMENTAL COMPLIANCE TECHNOLOGY	1291	1600	2721	0	0	0	0	0	0	0
025 POLLUTION PREVENTION TECHNOLOGY	0	0	0	0	0	0	0	0	0	0
03E ENVIRONMENTAL RESTORATION TECHNOLOGY	0	0	2105	0	0	0	0	0	0	0
03F CORROSION MEASUREMENT AND CONTROL	0	9413	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The objective of this program element (PE) is to mature and demonstrate technologies which will assist Army installations in becoming environmentally compatible without compromising the readiness or training critical to the success of the Objective Force. This program includes technology demonstrations for: restoration of sites contaminated with toxic and/or hazardous materials (such as unexploded ordnance [UXO]) resulting from Army operations; pollution prevention to minimize the Army's use and generation of toxic chemicals and hazardous wastes; compliance with environmental laws by control, treatment, and disposal of hazardous waste products; and conservation of natural and cultural resources while providing a realistic environment for mission activities. This program will include demonstrations of proof of technological feasibility and assessment of operability and producibility that would lead to a capability for Army use, and includes technology transition from the laboratory to operational use. The program is supported by the Office of the Secretary of Defense's Technology Area Review and Assessment process. This PE develops and demonstrates technology to improve the Army's ability to achieve environmental restoration and compliance at its installations, at active and inactive ranges, and its rework and production facilities. Technologies demonstrated will focus on reducing the cost of remediation of Army sites contaminated by hazardous/toxic materiel. Other technologies 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. These technologies are essential for cost-effective removal, control and reduced generation of wastes to satisfy hazardous waste cleanup and reduction goals, and to avoid future hazardous waste site cleanup and disposal costs and liabilities to the Army. Efforts under this PE will enable the Army's Objective Force to prevent pollution of the air, soil, and groundwater at installations, ranges, facilities operations, and to comply with the myriad of Federal, state, and host country regulations dealing with contaminated soil, groundwater, wastewater, air emissions, and solid wastes. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The PE contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center (ERDC) and the U.S. Army Materiel Command (AMC).

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603728A - Environmental Quality Technology Demo**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	1327	1616	2708	0
Appropriated Value	1337	11116	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-36	0	0	
c. Omnibus or Other Above Threshold Reductions	-5	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-5	-103	0	
Adjustments to Budget Years Since FY2001 PB	0	0	2118	
Current Budget Submit (FY 2002/2003 PB )	1291	11013	4826	0

Change Summary Explanation: Funding - FY 2001: Congressional add was received for Corrosion Measurement and Control to demonstrate techniques for detecting, inhibiting, and reporting corrosion on weapon systems(+9500). No additional funds are required to complete this project.

FY 2002 (+2105) and FY 2003 (+6305) funding was increased to develop and demonstrate new and improved techniques for the restoration of Army sites contaminated with toxic and/or hazardous materials including unexploded ordnance.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603728A - Environmental Quality Technology Demo**      PROJECT  
**002**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
002 ENVIRONMENTAL COMPLIANCE TECHNOLOGY	1291	1600	2721	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to develop and demonstrate technology for achieving environmental compliance at Army installations and rework and production facilities. Technology demonstrated within this project focuses 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 while complying 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). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 605 - Developed cost effective technologies to remove, characterize, and dispose of or reuse sources of Army unique lead hazards.
  - 686 - Developed Hazardous Air Pollutant (HAP) mission control technologies for Army unique pollutants (to be completed in FY 2005).
- Total 1291

**FY 2001 Planned Program**

- 866 - Demonstrate optimal selection of overcoatings and overcoating procedures resulting in a potential cost avoidance of up to 20 percent over current technologies.
  - 686 - Demonstrate Mobile Zone Recirculation system with thermal oxidation for control of hazardous organic solvents.
  - 48 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 1600

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603728A - Environmental Quality Technology Demo**

PROJECT  
**002**

## FY 2002 Planned Program

- 2721 - Demonstrate in-situ extraction technologies for lead in soil to reduce lead levels to below the Environmental Protection Agency's level of concern (400ppm).  
- Demonstrate hazardous organic solvent emissions technologies to remove 95 percent of HAP's and 20 percent cost reduction (baseline - 10,000 cfm unit at \$65/cfm).

Total 2721

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603728A - Environmental Quality Technology Demo**      PROJECT  
**03E**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
03E ENVIRONMENTAL RESTORATION TECHNOLOGY	0	0	2105	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to develop and demonstrate new and improved techniques for the restoration of Army sites contaminated with toxic and/or hazardous materials including unexploded ordnance (UXO). This project develops and demonstrates technology to improve the Army's ability to achieve cost-effective environmental restoration of contaminated sites at its installations, active and inactive ranges, and its rework and production facilities. Technologies demonstrated within this project focus on reducing the cost of remediation of Army sites contaminated by hazardous/toxic material and are directly linked to RDT&E Budget Activity 2 technology products originating from program element 0602720A, projects F25 and 835. These technologies are essential for cost-effective removal of hazardous and toxic chemicals and other contaminants to satisfy hazardous waste cleanup goals. Efforts under this project will enable the Army to prevent pollution of the air, soil, and groundwater at installations, ranges, facilities operations, and to comply with the myriad of Federal, state, and host country regulations dealing with contaminated soil and groundwater. This program includes demonstrations of proof of technological feasibility and assessments of operability and productivity that would lead to a capability for Army use, and includes technology transition from the laboratory to demonstration/validation funded under RDT&E program element 0603779, project 04E. The program is supported by the Office of the Secretary of Defense's Technology Area Review and Assessment process. The primary developing agency for this project is the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

Project not funded in FY 2000.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603728A - Environmental Quality Technology Demo**

PROJECT  
**03E**

## FY 2001 Planned Program

Project not funded in FY 2001.

## FY 2002 Planned Program

- 1052 - Conduct a demonstration of off-the-shelf UXO sensor fusion analysis methods and techniques for UXO detection/discrimination
- Conduct a demonstration of predictive tools for UXO multi-contaminant transport processes in various earth media.
- Formulate a demonstration plan for a series of UXO detection/discrimination multi-sensing and processing methods, each tailored to a specific set of site environmental conditions.
- 1053 - Formulate a predictive model demonstration to determine explosives toxicity for avian and marine species.
- Formulate a demonstration of a multi-species model for multi-contaminant pathways.

Total 2105

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603734A - Military Engineering Advanced Technology**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	15338	5160	4747	0	0	0	0	0	0	0
T08 COMBAT ENG SYSTEMS	3645	5160	4747	0	0	0	0	0	0	0
T12 RAPID TERRAIN VISUALIZATION	11693	0	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

The objective of this program element (PE) is to mature and demonstrate technologies that provide capabilities required for the engineer and logistician to successfully plan, rehearse and execute missions in support of the commander and the transformed 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 PE 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 PE is aligned with the Army's vision for the Objective Force and is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The PE contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Engineer Research and Development Center (ERDC).



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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603734A - Military Engineering Advanced Technology**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	15762	5207	4725	0
Appropriated Value	15881	5207	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-424	0	0	
c. Omnibus or Other Above Threshold Reductions	-64	0	0	
d. Below Threshold Reprogramming	0	0	0	
e. Rescissions	-55	-47	0	
Adjustments to Budget Years Since FY2001 PB	0	0	22	
Current Budget Submit (FY 2002/2003 PB )	15338	5160	4747	0

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603734A - Military Engineering Advanced  
Technology**

PROJECT  
**T08**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
T08 COMBAT ENG SYSTEMS	3645	5160	4747	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** The objective of this project is to demonstrate, at full scale, a capability to conduct logistics-over-the-shore (LOTS) operations at sea-state 3 (significant wave height - approx. 3 to 5 feet). 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. This directly supports the Chief of Staff's requirement to put a combat capable brigade anywhere in the world in 96 hours, a division on the ground in 120 hours, and five divisions in 30 days. In the event that ports do not exist in the area of operations or that ports are inadequate or access to ports is denied through enemy action or geopolitical considerations, LOTS/JLOTS operations will be required to close the force. LOTS/JLOTS can also be used to augment existing available port facilities and to shorten lines of communication to enhance the Commander in Chief (CINC) scheme of maneuver. Present LOTS operations are limited to Sea State 2 (significant wave heights - approx. 1 to 3 feet) or less; this is an unacceptable limitation to force projection and Chairman of the Joint Chiefs of Staff (CJCS) has mandated Sea State 3 capability by 2005. A complete engineering design of a full-scale Rapidly Installed Breakwater (RIB) will be developed based on detailed engineering analyses, and laboratory and 1/4-scale field tests. In the final year of the ATD, a full-scale demonstration of the RIB that reduces Sea State 3 wave conditions 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. Note: Sea-state is based on the Pierson - Moskowitz Sea Spectrum which includes wind, wave height and frequency. The work is performed by the U.S. Army Engineer Research and Development Center (ERDC). This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1495 - Completed initial engineering design for full-scale RIB based on detailed engineering analyses, laboratory tests, and ocean scale field tests; provided the capability to rapidly stabilize beach sands with minimum logistics burdens and reduced engineer equipment.
- Completed initial engineering design for full-scale RIB mooring system that incorporates high strength mooring line, elastomers, and high holding power/non-slip anchors.
- 450 - Developed concept for RIB Advanced Technology Demonstration (ATD) to include RIB deployment and sandy beach field demonstration.

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603734A - Military Engineering Advanced  
Technology**

PROJECT

**T08****FY 2000 Accomplishments (Continued)**

- 1700 - Completed field test of mid-scale final version ATD RIB that demonstrated: mooring system; potential employment methods; fabrication advances; and survivability options.

Total 3645

**FY 2001 Planned Program**

- 3417 - Develop RIB XM 2001 (two segments per leg) to include: fabrication of four interchangeable RIB segments and connectors; design, procurement, and testing of mooring system for RIB XM 2001; demonstration of RIB employment alternative(s); fabrication of Nose Assembly for RIB.
- 179 - Complete final design of RIB Nose Section.
- 298 - Complete final design of ATD RIB to be used in FY 2002.
- 218 - Complete plans for FY 2002 ATD.
- 894 - Provide plan, acquire materials for FY 2002 ATD sandy beach stabilization demonstration.
- 154 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 5160

**FY 2002 Planned Program**

- 3722 - Perform ATD Field Demonstration to include: fabrication of four interchangeable RIB Segments; deployment of full scale full length RIB; and employment/recovery of RIB by barge system.
- 400 - Design, procure, and deploy ATD RIB mooring system.
- 300 - Demonstrate ATD Beach Stabilization Technology.
- 325 - Design ATD RIB System and Beach Stabilization methodology.  
- Fabricate additional segments to be used with the engineering development model tested in FY 2001.

Total 4747

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603772A - Advanced Tactical Computer Science & Sensor  
 Tech**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	27144	15470	18513	0	0	0	0	0	0	0
101 TACTICAL AUTOMATION	17969	10348	15410	0	0	0	0	0	0	0
243 SENSORS & SIGNALS PROC	6311	5122	3103	0	0	0	0	0	0	0
285 COLLABORATIVE TELEMANTENANCE	2864	0	0	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) supports information dominance for the Army's Objective Force. It will allow forces to more effectively transfer and display digital information. The PE provides architectures and products to correct command and control (C2) deficiencies impacting rapid mobile operations. It addresses technologies necessary for integrated battlefield situational awareness (SA), force synchronization, data correlation, tactical surveillance, and combat identification. Additionally, the technologies support split-based, and on-the move (OTM) C2 operations. It also has application to radar/signal processing. Technology solutions from this PE will be demonstrated in the Agile Commander Advanced Technology Demonstration (ATD) and the Logistics C2 (Log C2) ATD. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this PE is related to and fully coordinated with PE 0602783A (Computer and Software Technology), PE 0602782A (Command, Control and Communications Technology), and PE 0602120A (Sensors and Electronic Survivability). The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command (CECOM), Fort Monmouth, NJ.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603772A - Advanced Tactical Computer Science & Sensor  
 Tech**

<u><b>B. Program Change Summary</b></u>	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	27392	15613	20462	0
Appropriated Value	27610	15613	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-565	0	0	
c. Omnibus or Other Above Threshold Reductions	-87	0	0	
d. Below Threshold Reprogramming	317	0	0	
e. Rescissions	-131	-143	0	
Adjustments to Budget Years Since FY2001 PB	0	0	-1949	
Current Budget Submit (FY 2002/2003 PB )	27144	15470	18513	0

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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>			PE NUMBER AND TITLE <b>0603772A - Advanced Tactical Computer Science &amp; Sensor Tech</b>					PROJECT <b>101</b>		
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
101 TACTICAL AUTOMATION	17969	10348	15410	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This program provides improved architectures and products for Objective Force information dominance. Program goals include improved force synchronization and reduced fratricide. This PE matures technologies necessary for display of a common view of the battlefield. It matures advanced computer science and technology (S&T) solutions addressing: (1) digital transfer and display of horizontal battlefield SA; (2) synchronization of combined and joint force operations; and (3) C2 OTM. This project researches and investigates key technologies in the following areas: automated decision support; advanced database development and distribution; data compression; dynamic digital display and manipulation; web-based architectures; and automated navigation/geopositioning. The Agile Commander ATD will demonstrate digital hardware and software technologies providing agile, rapidly deployable, split-based C2 operations. The Log C2 ATD will mature course-of-action analysis (COAA) and support software tools for combat service support and operational commanders. Joint developer/warfighter demonstrations will be conducted in coordination with the Mounted, Dismounted, Battle Command and Combat Service Support Battle Labs. Products will be transitioned to Program Executive Offices (PEOs) for integration. This project supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 4888 - Scaled, tailored, and expanded visualization products/tools to the battalion/company level to provide faster, more accurate, more intuitive mission tailored information to the commander/staff at brigade/division level.
- 3026 - Matured a human-in-the-loop capability to provide real-time COAA and revision during its execution within a wargame.
- 3724 - Demonstrated execution monitoring tools to 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.
- 2116 - Demonstrated Force XXI Battle Command Brigade and Below (FBCB2) automatic data exchange to Global Combat Service Support - Army (GCSS-A) in response to logistics operations planning criteria (LOPC); demonstrated software that combined multiple databases into a web accessible virtual database for the Combat Service Support Control System (CSSCS).
- 317 - Evolved architecture for integration of the Defense Advanced Research Projects Agency's (DARPA) Advanced Logistics Project (ALP) with the Distributed Analysis and Visualization Infrastructure for C4I (DAVINCI).
- 1948 - Selected technologies and developed architecture approach for C2 products capable of dispersed, highly mobile, OTM operations.

**ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)****June 2001**

BUDGET ACTIVITY

**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE

**0603772A - Advanced Tactical Computer Science &  
Sensor Tech**

PROJECT

**101****FY 2000 Accomplishments (Continued)**

- 1950 - Achieved objectives of this one year Congressional special interest effort: matured enhanced physical and communications security features, and improved the ruggedness of the handheld Digital Intelligence Situation Mapboard, which interchanges and displays map-based SA information among individual dismounted soldiers and base stations.

Total 17969

**FY 2001 Planned Program**

- 4362 - Demonstrate in the laboratory, deliberate course of action (COA) software with logistics data inputs and automatic alerts for rapid replanning. Demonstrate decision support software that optimizes weapon system management based on current fuel, ammunition, and major end item SA to improve readiness and resource utilization.
- 5852 - Demonstrate in the laboratory, initial semi-automated COA and COAA tools for dispersed, highly mobile and OTM operations. Demonstrate a Microsoft Windows-based version of the Advanced Field Artillery Tactical Data System (AFATDS). Mature and demonstrate initial terrain reasoning capability.
- 134 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 10348

**FY 2002 Planned Program**

- 5081 - Demonstrate GCSS-A to CSSCS on-line data exchange. Demonstrate logistics COA development software and intelligent agents in an Advanced Warfighting Experiment (AWE) or National Training Center (NTC) rotation. Demonstrate decision support software tools for combat commanders to plan crewing.
- 7348 - Demonstrate advanced COA generation software tools to support battle management and enable the commander to rapidly develop and compare courses of action in a collaborative environment that supports parallel planning at different echelons. Mature initial mobile adaptive computing software. Demonstrate prototype human-computer interface suite that integrates voice recognition with other modalities and includes high information content displays.
- 2981 - Evolve performance requirements for a common C2 and intelligence database to provide tactical forces a real-time, integrated Red and Blue forces picture with the capability to drill down to the underlying sensor data. Define battlespace visualization requirements. Adapt COA tools, traditionally designed for the maneuver commander, to integrate C2, intelligence and resource allocation data to reduce workload of mission planners.

Total 15410

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

**June 2001**

**BUDGET ACTIVITY  
3 - ADV TECHNOLOGY DEV**

**PE NUMBER AND TITLE  
0603772A - Advanced Tactical Computer Science &  
Sensor Tech**

**PROJECT  
101**



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

June 2001

BUDGET ACTIVITY <b>3 - ADV TECHNOLOGY DEV</b>				PE NUMBER AND TITLE <b>0603772A - Advanced Tactical Computer Science &amp; Sensor Tech</b>					PROJECT <b>243</b>	
COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
243    SENSORS & SIGNALS PROC	6311	5122	3103	0	0	0	0	0	0	0

**A. Mission Description and Budget Item Justification:** This project matures and demonstrates advanced radar and signal processing technologies for reconnaissance, surveillance, target acquisition (RSTA), counter battery, and navigation applications. The goal is to demonstrate an interchangeable, lightweight, low cost sensor suite equipped with moving-target-indicator (MTI)/synthetic aperture radar (SAR) and electro-optical (EO)/IR technologies. This sensor suite, developed under PE 0603710A, will provide manned and tactical Unmanned Aerial Vehicles (UAVs) with wide area surveillance capability in adverse weather. Additionally, new generation radar jointly developed by the Army, Air Force and the DARPA, will provide foliage and ground penetrating technology for aerial surveillance and targeting. Further, Army reconnaissance and attack helicopters will be outfitted with an electronically scanned radar to provide highly reliable, affordable multi-role sensor capabilities for targeting, combat identification, and terrain avoidance. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 3904 - Completed MTI/SAR sensor development and subsystem integration and performed laboratory bench testing to verify functionality.
- 2407 - Conducted engineering flight tests to characterize the capabilities of the foliage penetrating (FOPEN) SAR in detecting tactical targets hidden by foliage and/or camouflage cover.
  - Refined the algorithms to reduce false alarms to enhance the effectiveness of the automatic target detection and cueing in providing valid targets.

Total 6311

**FY 2001 Planned Program**

- 1934 - Evaluate ground post processing of FOPEN data with a goal of reducing the clutter false alarms by an order of magnitude so an image analyst can effectively discriminate tactical targets embedded in heavy foliage.
  - Continue engineering flight tests to characterize the capabilities of the FOPEN SAR in detecting tactical targets hidden by foliage and/or camouflage cover.

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

June 2001

BUDGET ACTIVITY  
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE  
**0603772A - Advanced Tactical Computer Science &  
 Sensor Tech**

PROJECT  
**243**

**FY 2001 Planned Program (Continued)**

- Continue refining the algorithms to reduce false alarms to enhance the effectiveness of the automatic target detection and cueing in providing valid targets.
- 2851 - Complete airborne testing of multi-mission UAV MTI/SAR sensor payload and data collection and verify performance through data analysis.
- Test sensor payloads under environmental extremes for shock, vibration, temperature, altitude, etc.
- Conduct instrumented flight testing under dynamic flight conditions to characterize MTI/SAR sensor performance in surveillance and targeting roles.
- Participate in operational demonstrations for military assessment of multifunctional sensor suite on a tactical UAV.
- 215 - Initiate system study for preparation of the multi-mission radar procurement package.
- 122 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 5122

**FY 2002 Planned Program**

- 1303 - Conduct preliminary design review for the multi-mission radar program and develop simulation plan.
- 1800 - Conduct verification test to evaluate the achieved performance and determine the readiness of a FOPEN SAR for participation in an operational demonstration.
- 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 to use the FOPEN SAR in support of potential users such as European Command and Southern Command.
- Total 3103

**End of P&R Forms Report**

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