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Supporting Data FY 1996 / FY 1997 Biennial Budget Estimate
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DESCRIPTIVE SUMMARIES OF THE

AD-A286 766

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

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DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY OF THE ARMY (FINANCIAL MANAGEMENT)

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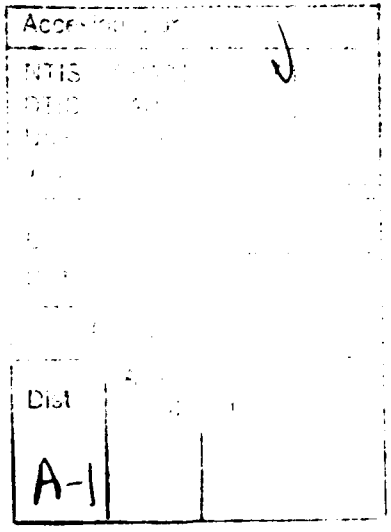
VOLUME I

95-01259

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DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS OF THE RESEARCH, DEVELOPMENT, TEST AND EVALUATION, ARMY FY 1996/FY 1997



VOLUME I

Budget Activities 1, 2, and 3

Department of the Army

Office of the Assistant Secretary of the Army (Financial Management)

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FY 1996/1997 RDT&E, ARMY
PROGRAM ELEMENT DESCRIPTIVE SUMMARIES

INTRODUCTION AND EXPLANATION OF CONTENTS

1. **General.** This section has been prepared for the purpose of providing information concerning the U.S. Army Research, Development, Test and Evaluation program. The Descriptive Summaries provide narrative information on all RDT&E, A program elements and projects. Because of new and expanded formats, this document now consists of three volumes. A brief explanation of the new formats is provided in paragraph 6 at the end of this section.

2. **Relationship of FY 1996 Budget Submission to the FY 1995 Budget submitted to Congress.** This paragraph provides a list of program elements restructured, transitioned, or established to provide specific program identification.

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

OLD PE/PROJECT	TITLE	NEW PE/PROJECT
0203802/D685	ATACMS BLKII	0604768/D688
0602601/DC05	Tractor Card	0602601/DC83
0603012/DC24	STARLOS	0603238/D546
0603238/D182	STARLOS	0603238/D546
0603322/DB93	Tractor Cage	0603322/DB92
0603322/DBB1	Tractor Cage	0603322/DB92
0603005/D221	Non Ozone Depleting Substitutes Technology	0602601/AH82
0603730/D560	Tactical Surveillance System - Advance Development	0603766/D907

Program Restructures (Continued)

OLD PE/PROJECT	TITLE	NEW PE/PROJECT
0604740/D662	Tactical Surveillance System - Engineering Development	0604766/D909
0604741/D126	Air Defense Tactical Operations Center	0604741/D146
0604746/DL10	Electro-Optic (EO) Test Equipment	0604746/DL59
0604746/D537	Integrated Family of Test Equipment	0604746/DL59
0604804/DH01	Camouflage System Engineering Development	0604804/DL42
0605602/D453	Technical Test Instrumentation	0604759/D984
0605604/D089	Aircraft Certification	0605606/D092
0605801/MAC3	Ozone Depleting Chemical Elimination	0605854/M7PP
0605801/MAC4	Pollution Prevention	0605854/M8PP

Applicable portions of PE 0605856A, Environmental Compliance were restructured to new PEs for Environmental Conservation (PE 0605853A) and Pollution Prevention (PE 0605854A). Host Nation Compliance in PE 0605301A has been restructured to PE 0605856A and the new PEs, 0605853A and 0605854A.

Multiple projects within PE 0601102A, Defense Research Sciences, were restructured into new projects in PE 0601104A which has been renamed University/Industry Research Centers. These projects fund the federated Army Research Laboratory (ARL). The federated approach involves the creation of a distributed, multi-center external component of ARL, leveraging industry and academic laboratories nationally recognized for technical competence in areas essential to the Army.

Portions of PE 0605702A, 0605710A and 0605604A have been restructured into new projects in PE 0605604A to provide visibility for survivability/lethality projects as grouped by system categories.

Program Restructures (Continued)

Funding from twenty-four Army RDT&E Chemical/Biological Defense projects spread throughout the seven Budget Activities were transferred to the Joint Chemical Biological Defense appropriation under Office of the Secretary of Defense management based on Congressional direction. These transfers are shown in the applicable project R-2 Exhibits.

B. Establishment of New Program Elements/Projects. There are no major system new starts. Minor new initiatives for FY 1996 are shown below with asterisks. The remaining programs listed are outyear initiatives beyond FY 1997.

TITLE	PE/PROJECT
Improved Cargo Helicopter *	0203744/D430
Army Missile Defense Systems Integration*	0603308/D990
Advance Missile System, Heavy	0604325/DE18
Kiowa Warrior CSMET *	0604220/D538
Aviation Combat Arms Tactical Trainer (AVCATT)	0604780/D581
Engineer Combat Arms Tactical Trainer (ENCATT)	0604780/D582
Fire Support Combat Arms Tactical Trainer (FSCATT)	0604780/D583
Longbow-Apache TESS *	0604816/DC87
TROJAN Development (TIARA) *	0604270/DL16

C. FY 1996 Programs for which funding was shown in the FY 1995 President's Budget Submit (February 1994), but which are no longer funded.

PE/PROJECT	TITLE	BRIEF EXPLANATION
0305150/D914	Airborne Reconnaissance Low (ARL)	Program transferred to OSD.
0602786/A427	Tactical Shelter ED	Program completed.
0603001/DJ28	Test Measurement Tech Dev	Funding resumes in FY 1997.
0604604/DH07	Family of Medium Tactical Vehicles	Development program complete.
0603122/DB95	Tractor Hip	Program terminated.
0605805/D620	DoD Munitions Effects	Program transferred to OSD.
0605604/D235	Missile Counter/Countermeasure Tech	Program terminated.
0605810/DE65	NDI Testing	Efforts funded in system PEs.
0605810/D125	NDI Market Investigations	Efforts funded in system PEs.

3. Classified/Special Access Programs which are submitted offline through OSD are listed below.

0203744, Project DB75
0203806
0203808
0301359
0602104
0602122
0602601, Project DC83
0602788
0603003, Projects DB38 and D391
0603012
0603014
0603018
0603019
0603020
0603238, Projects D182 and D189
0603322
0603647
0603851
0604018
0604328
0603017

4. Program Element number 0603639A is classified SECRET and will be provided upon request.

5. **Classification.** This document no longer contains any classified data.

6. **New Formats**. The Department of Defense Financial Management Regulation 7000.14-R, dated May 1994 required the Services to prepare the RDT&E Descriptive Summaries in new formats which are described below. The change in formats increased the overall size of the publication which is now being provided in three volumes.

A. **RDT&E Budget Item Justification Sheet (R-2)** provides a resource summary table for all projects and the total Program Element. Paragraph A provides descriptions and justifications for the Program Element and for each Project; Paragraph B provides a Program Change Summary for the total Program Element which shows FY 1994-FY 1997 Previous President's Budget submit funding and the current FY 1994-FY 1997 President's Budget Submit. Note that the FY95 Appropriated value represents the Congressionally approved funding less the amounts decremented by the Congressional undistributed reductions, but before the Small Business Innovation Research/Small Business Technology Transfer tax has been applied. Additional R-2 Exhibits are provided for each project to show other related appropriation funding (Paragraph C) and schedule/milestone profiles (Paragraph D). Paragraphs C and D are not provided if there is no other related appropriation funding and if milestone schedules do not apply.

B . **Program Element/Project Cost Breakdown (R-3)** This Exhibit is prepared for each project in Budget Activities 4, 5 or 7 funded in FY 1995, FY 1996 or FY 1997. Those same projects which meet certain criteria will also show Paragraph B, Budget Acquisition and Planning Information. The criteria for requiring that this information be provided is at least one of the following: Major Defense Acquisition Program, funding revisions of greater than plus or minus 10 percent since the FY 1995 President's Budget request, major milestone schedule change of more than six months, or is a new start.

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6	0602211A	Aviation Technology	78
7	0602270A	EW Technology	89
8	0602303A	Missile Technology	96
9	0602307A	Advanced Weapons Technology	100
10	0602308A	Modeling And Simulation	102
11	0602601A	Cmbt Veh And Automotive Tech	110
12	0602618A	Ballistics Technology	118
13	0602622A	Chem, Smoke And Equip Defeating Tech	124
14	0602623A	Joint Service Small Arms Program	131
15	0602624A	Weapons & Munitions Technology	133
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22	0602784A	Military Engineering Technology	179
23	0602785A	Manpower/Personnel/Trng Technology	189
24	0602786A	Logistics Technology	194
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26	0602789A	Army Artificial Intelligence Technology	217
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42	0603734A	Military Engineering Adv Tech	364
43	0603759A	Chem Bio Def And Smoke Adv Tech	370
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1995

BUDGET ACTIVITY: 1 - Basic Research

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

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	10778	13532	14340	15028	16452	17543	18280	19497	Continuing	Continuing
A91A In-House Laboratory Independent Research - Army Materiel Command	4765	8485	9513	10078	11023	11966	12512	13572	Continuing	Continuing
A91C In-House Laboratory Independent Research - Medical Research and Development Command	5153	4102	3924	4026	4413	4533	4687	4815	Continuing	Continuing
A91D In-House Laboratory Independent Research - Corps of Engineers	742	807	773	791	868	892	923	948	Continuing	Continuing
A91E In-House Laboratory Independent Research - Army Research Institute of Behavioral and Social Sciences	118	138	130	133	148	152	158	162	Continuing	Continuing

A. **Mission Description and Budget Item Justification:** In-House Laboratory Independent Research (ILIR) provides a source of competitive funds to technical directors to stimulate high quality, innovative research with significant opportunity for payoff in Army warfighting capability. Consistent with BRAC 91 and the formation of the Army Research Laboratory, and as presented in 1991 to the Federal Advisory Commission on Consolidation and Conversion of Defense Research and Development Laboratories, beginning in FY 95, Research, Development and Engineering Center (RDEC) 6.1 funding is shifted in a zero sum manner from both PE 0601101A and PE 0601102A funds to only PE 0601101A, ILIR, funds. Hence, the rise in PE 0601101A funding in this budget and the Future Years Defense Program (FYDP). This strategy strengthens the basic research program at the Army's corporate laboratory, the Army Research Laboratory, while providing the Research, Development and Engineering Centers (RDECs) with a source of innovative research funding. The ILIR program serves as a catalyst for major technology breakthroughs by giving laboratory directors flexibility in implementing and cultivating research ideas, and nurturing senior researchers as well as the most promising, developing scientists. ILIR funding allocation is based on the quality of past performance. ILIR reports are submitted from competing Army research organizations to the Office of the Assistant Secretary of Army (Research, Development, and Acquisition) and, following a strenuous technical peer review by leading scientists and engineers from the National Academy of Sciences, the Army Science Board, and Army Secretariat, the ILIR funding allocation for the performing organizations is determined. Successful ILIR projects, on completion, typically define start-up projects for (6.1) or (6.2) mission funding within the organization. For example, research at the Missile Command Research, Development, and Engineering Center (MRDEC) in insensitive munition solid fuel generator/oxidizer gel propulsion led to three patent awards and transitioned to a technology base core program in FY94. Research at the Tank-Automotive Command Research, Development and Engineering Center (TARDEC) in extending computational models of early vision to the prediction of detection and false alarm probabilities for complex target/background scenarios resulted in a Cooperative Research and Development Agreement (CRDA) with General Motors Corporation. The ILIR program is established by DoD Directive number 3201.4, dated October 8, 1993, and supports the 1987 Defense

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Science Board Summer Study on Technology Base Management and the recommendation to attract and retain top flight science and engineering PhDs. The projects in this PE explore fundamental concepts in science and technology and therefore are correctly placed in Budget Activity 1.

Project A91A - In-House Laboratory Independent Research (ILIR) - Army Materiel Command: This project provides the initial ILIR allocation for Research, Development and Engineering Centers (RDECs) in the Army Materiel Command (AMC).

FY 1994 Accomplishments:

- Armaments RDEC - Developed improved warhead explosives using Zeolite catalysts and improved target detection with acoustic sensors; performed anti-fratricide munitions experimentation; developed a neural network automatic loader control system (1001)
- Communications and Electronics RDEC - Completed design of dry-etch micro-electronics circuit processing chamber; developed a micro-strip, dual-frequency antenna; demonstrated a weapons control voice recognition system (1334)
- Natick RDEC - Completed fractal analyses for applications to chemical protective clothing, camouflage, and rations, demonstrated the migration of moisture through different bilayered biopolymers controlled by matrix composition; developed models of parachute stability in transient motion (191)
- Edgewood RDEC - Demonstrated aerosol antibodies remain active for a sustained period of time in when exposed to air (620)
- Aviation RDEC - Modelec the unsteady flowfield of the AH-1 rotor in forward motion; measured and evaluated dynamic stall characteristics (620)
- Missile RDEC - Demonstrated a hybrid rocket propulsion system; developed a neural network controller for multi-sensor arrays; analyzed ground vehicle signature for improved targeting (762)
- Tank-Automotive RDEC - Demonstrated a synthetic polarimetric image database to enhance target recognition; determined the effects of high temperature combustion in low heat rejection engines (237)

FY 1995 Planned Program:

- Armaments RDEC - Perfo m experiments in gun dynamics, alternate power sources, target recognition and warhead phenomena to enhance gun technologies (1445)
- Missile RDEC - Continue experimentation to lower the threshold condition of photonic laser diodes; develop a measurement technique for fiber optic cable stress during flyouts; analyze improved rocket propellant bonding agents (1135)
- Tank-Automotive RDEC - Analyze the Laplacian pyramid model of target cue and detection to better predict human performance; develop and evaluate intelligent suspension control systems to optimize the cross country performance of HMMWVs; derive fundamental insights into the physical mechanisms and phenomena of advanced diesel engines (790)
- Natick RDEC - Continue to apply fractal analyses to molecular absorption and biodegradable materials; develop biomaterials that can respond to a changing environment; develop a predictive computer model of responses to product dissatisfaction in closed environments (690)
- Edgewood RDEC - Experimentally verify that aerosol antibodies retain their biological activity when dispersed into air; investigate the synthesis parameters for Epibatidine, a new class of analgesics (1445)
- Aviation RDEC - Investigate the effects of leading and trailing edge rotor blade design and expand knowledge of rotor behavior in forward flight; develop a neural network based helicopter simulator system; develop and evaluate a slotted airfoil rotor blade (1232)

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- Communications-Electronics RDEC - Complete hypercube and braided-ring topologies for multi-sensor platforms; develop intelligence information fusion algorithms and computer network analysis techniques (1570)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (178)

FY 1996 Planned Program:

- Missile RDEC - Conduct research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities. Demonstrate and transition component and concepts (1319)
- Armaments RDEC - Evaluate unique phenomena in superconductivity, barrel plating to reduce barrel wear and lower acoustical noise; aid hypervelocity research (1663)
- Tank-Automotive RDEC - Develop nonlinear models of compliant structures, heat transfer mechanisms for cold start engine phenomena, and non-invasive thermal imaging of engine combustion phenomena (889)
- Natick RDEC - Identify innovative technologies in the areas of molecular migration in biopolymers and modeling of parachute instability and transition results to 6.1/6.2 core programs (774)
- Edgewood RDEC - Investigate smoke-obscurant technologies (1663)
- Aviation RDEC - Test and measure dynamic stall characteristics; provide software for Artificial Intelligence/Neural Networks to the helicopter community for smart structures, advanced controls and reduction in operating costs (1437)
- Communications-Electronics RDEC - Transition antenna programs to core tech base; develop models to enhance imaging sensors capabilities; develop more efficient algorithms for IEW data fusion; upgrade sensor simulation/performance models (1768)

FY 1997 Planned Program:

- Missile RDEC - Conduct research on high quality projects leading to new and improved missile and related technologies. Demonstrate and transition components and concepts (1408)
- Armaments RDEC - Evaluate unique phenomena in weapons and munitions related research. (1752)
- Tank-Automotive RDEC - Develop an improved understanding of advanced diesel engine technology through nonlinear models of compliant structures, heat transfer mechanisms for cold start engine phenomena, and non-invasive thermal imaging of engine combustion phenomena. (932)
- Natick RDEC - Identify innovative technologies in the areas of molecular biology, biopolymers and modeling of personnel equipment characteristics. Transition results to 6.1/6.2 core programs (820)
- Edgewood RDEC -Investigate smoke/obscurant technologies (1752)
- Aviation RDEC - Test and measure aircraft in-flight characteristics; provide software for Artificial Intelligence/Neural Networks to the helicopter community for smart structures, advanced controls and reduction in operating costs. (1530)
- Communications-Electronics RDEC - Develop antenna and sensor technologies and computer models; improve intelligence data fusion techniques; upgrade sensor simulation/performance models. (1884)

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Project A91C - In-House Laboratory Independent Research (ILIR) - Medical Research and Development Command: Represents allocation of funds for the 6 laboratories within the Medical Research and Development Command to conduct ILIR research.

FY 1994 Accomplishments:
- Supported innovative projects to test molecular strategies for subunit vaccines (1752)
- Developed on-line sensors to monitor physiological status (103)
- Developed a "get-out-of-trouble" aircraft display (103)
- Developed a virus replicon as a universal vaccine vector (103)
- Developed a biophysical basis of enzyme activity (3092)

FY 1995 Planned Program:
- Support innovative projects to test molecular mechanisms for immunity against disease (2330)
- Develop a high pressure, low volume surgical irrigator (184)
- Develop a gender-free, head-supported-mass criteria for aviators (155)
- Develop a computer prediction of iconic channel-forming regions in toxins (1347)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (86)

FY 1996 Planned Program:
- Continue research in medical countermeasures against naturally occurring infectious diseases which can have significant impacts on military operations to protect the force from infection and sustain operations. (2320)
- Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness. (148)
- Continue research in medical defense against aggressor weapons systems by understanding the basic mechanisms of combat related trauma, identifying innovative treatment and surgical procedures to extend the "golden hour" following trauma. (1456)

FY 1997 Planned Program:
- Continue research for medical countermeasures against naturally occurring infectious diseases which can have significant impacts on military operations to protect the force from infection and sustain operations. (2378)
- Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness. (153)
- Continue research in medical defense against aggressor weapons systems by understanding the basic mechanisms of combat related trauma, identifying innovative treatment and surgical procedures to extend the "golden hour" following trauma. (1495)

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Project A91D - In-House Laboratory Independent Research (ILIR) - Corps of Engineers: Represents allocation of funds for the 4 laboratories within the Army Corps of Engineers to conduct ILIR research.

FY 1994 Accomplishments:

- Applied terrain edge detection algorithms to synthetic aperture radar; demonstrated automatic detection and delineation of buildings from mapping and reconnaissance imagery at the Topographical Engineering Center (200)
- Developed 2D and 3D computer models of ground water flow using finite element methods; developed soil analysis methods to be used in locating buried structures at the Waterways Experimental Station (282)
- Demonstrated quantum control technique by producing Magnetic Resonance Imaging scan with automatic contrast optimization; demonstrated improved techniques for acoustical imaging at the Construction Engineering Research Laboratories (67)
- Demonstrated the location of buried objects through radar scatter pattern analysis; developed computer models of sea ice anisotropy using radar pulse measurements; analyzed the movement of liquid water in snow cover during rain-on-snow and melt events at the Cold Regions Research and Engineering Laboratory (193)

FY 1995 Planned Program:

- Analyze syntactic methods and develop neural networks for pattern recognition to classify spectral data and reduce terrain database computer storage; develop parallel algorithms to produce high-resolution digital elevation models from stereo imagery at the Topographical Engineering Center (213)
- Develop a bioreactor for treatment of volatile organic compounds; analyze dynamic responses of brittle geomaterials to high velocity projectile impact at the Waterways Experimental Station (293)
- Design a methodology for verification and validation of computer models, systems simulations and distributed simulations at the Construction Engineering Research Laboratories (75)
- Develop a means to measure the thermal and electrical conductivities of snow; determine the indentation forces required to split an ice floe; analyze frost cracking patterns in soils at the Cold Regions Research and Engineering Laboratory (209)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (17)

FY 1996 Planned Program:

- Concentrate efforts in dynamic terrain representation for simulation and computerized terrain data analysis techniques at the Topographic Engineering Center (206)
- Develop chemical oxidation techniques for explosive contamination on oversized solids; enhance technology for identification and quantification of lighter petroleum fraction compounds at the Waterways Experimental Station (300)
- Simulate micro-mechanical motors fabricated by x-ray lithography (nano-technology) at the Construction Engineering Research Laboratories (70)
- Continue to study environmental factors such as liquid flows and soil, vegetation and equipment behavior at low temperatures at the Cold Regions Research and Engineering Laboratory (197)

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FY 1997 Planned Program:

- Continue research in the terrain representation process and terrain data generation by sponsoring related topics in these areas at the Topographic Engineering Center (210)
- Develop and improve knowledge of water, liquid and biomaterial behaviors at the Waterways Experimental Station (307)
- Improve construction practices and engineering knowledge; continue exploration of simulation verification and validation techniques to improve computer representations of structural reactions in various conditions at the Construction Engineering Research Laboratories (74)
- Continue to support innovative research projects to better understand the behavior of equipment, personnel, and environmental features in cold regions of the earth at the Cold Region Research and Engineering Laboratory (200)

Project A91E - In-House Laboratory Independent Research (ILIR) - Army Research Institute for Behavioral and Social Sciences: Represents allocation of funds for the Army Research Institute for Behavioral and Social Sciences to conduct ILIR research.

FY 1994 Accomplishments:

- Completed research on mental models and training strategies in troubleshooting skill acquisition (118)

FY 1995 Planned Program:

- Conduct research to determine the effects of team members' goals and terrain complexity on collective performance (135)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (3)

FY 1996 Planned Program:

- Conduct research on the application of technology-based training approaches for skill acquisition (130)

FY 1997 Planned Program:

- Conduct research on the validity of meta-analytic outcomes (133)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	10947	13717	17499	21847
Appropriated Value	10947	13532		
Adjustments to Appropriated Value	-169			
SBIR/STTR decrement (-169)				
Current President's Budget Submit	10778	13532	14340	15028

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DATE: February 1995

BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	185385	201706	127565	135285	142571	146859	152458	157380	Continuing	Continuing
AF20 Advanced Propulsion Research	2441	2321	2236	2372	2415	2467	2537	2594	Continuing	Continuing
AF22 Research in Vehicular Mobility	1283	3225	498	533	557	584	619	655	Continuing	Continuing
BH27 Research in Munitions Science	2092	1628	0	0	0	0	0	0	N/A	N/A
AH40 Signals Warfare Laboratory	696	566	0	0	0	0	0	0	N/A	N/A
AH42 Materials and Mechanics	3884	6484	1597	1885	2010	2169	2362	2545	Continuing	Continuing
AH43 Research in Ballistics	5344	5172	5059	5358	5484	5637	5831	5993	Continuing	Continuing
AH44 Advanced Sensors Research	2724	2629	1742	1897	1943	2003	2079	2146	Continuing	Continuing
AH45 Air Mobility	2885	2195	2034	2217	2333	2450	2578	2693	Continuing	Continuing
AH47 Applied Physics Research	6517	6319	2653	3043	3177	3354	3576	3779	Continuing	Continuing
AH48 Communications Research	1875	1463	0	0	0	0	0	0	N/A	N/A
AH49 Research in Missiles and High Energy Lasers	3878	3462	0	0	0	0	0	0	N/A	N/A
AH51 Combat Support	968	139	0	0	0	0	0	0	N/A	N/A
AH52 Equipment for the Soldier	2443	1934	991	1018	1041	1069	1105	1135	Continuing	Continuing
BH57 Scientific Problems with Military Applications	61647	63373	56084	58869	60687	62462	64886	67112	Continuing	Continuing
AH60 Research in Armaments	1820	1394	0	0	0	0	0	0	N/A	N/A
AH61 Research in Close Combat Weaponry	1350	1031	0	0	0	0	0	0	N/A	N/A

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PE NUMBER AND TITLE: 0601102A Defense Research Sciences

COST (*In Thousands*)		FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH66	Advanced Structures Research	1431	1362	1302	1381	1405	1436	1478	1512	Continuing	Continuing
BH67	Environmental Research - Army Materiel Command	4300	7587	5627	6067	8041	8266	8552	8788	Continuing	Continuing
AH68	Processes in Pollution Abatement Technology	441	432	400	420	459	471	488	501	Continuing	Continuing
BS04	Military Pollutants and Health Hazards	776	738	685	717	781	802	830	853	Continuing	Continuing
BS11	Science Base/Medical Chemical Defense	7980	7911	0	0	0	0	0	0	0	0
BS12	Science Base/Medical Biological Defense	16696	14887	0	0	0	0	0	0	0	0
BS13	Science Base/Medical Research Infectious Disease	8538	9736	9543	10107	10343	10632	10999	11305	Continuing	Continuing
BS14	Science Base/Combat Casualty Care Research	4223	4582	4336	4593	4700	4832	4998	5137	Continuing	Continuing
BS15	Science Base/System Health Hazards Research	8271	7396	6403	6788	7166	7366	7620	7832	Continuing	Continuing
BS16	Science Base/Combat Dentistry Research	240	544	496	561	577	593	613	630	Continuing	Continuing
BS17	Molecular Biology/Military HIV Research	1025	954	933	959	1033	1063	1098	1128	Continuing	Continuing
AT22	Soil and Rock Mechanics	1959	2046	2000	2118	2168	2229	2306	2370	Continuing	Continuing
AT23	Basic Research/Military Construction	1614	1776	1785	1838	1907	1960	2028	2084	Continuing	Continuing
AT24	Snow, Ice and Frozen Soil	1240	1305	1276	1352	1383	1421	1471	1513	Continuing	Continuing
BT25	Environmental Research - Corps of Engineers	2806	4758	3579	3860	5121	5264	5445	5596	Continuing	Continuing
A305	Automatic Target Recognition Research	1665	1617	1073	1169	1198	1234	1281	1320	Continuing	Continuing
A31B	Infrared Optics Research	2654	2478	2141	2288	2331	2387	2462	2523	Continuing	Continuing

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BUDGET ACTIVITY: 1 - Basic Research

PE NUMBER AND TITLE: 0601102A Defense Research Sciences

COST (*In Thousands*)		FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
B52C	Mapping and Remote Sensing	2487	2598	2539	2690	2 3	2829	2927	3008	Continuing	Continuing
B53A	Battlefield Environment and Signature	5469	5404	5321	5634	5767	5927	6132	6302	Continuing	Continuing
A71A	Research in Chemical Warfare/Biological Warfare Defense	4092	3014	0	0	0	0	0	0	0	0
B74A	Human Engineering	2603	2509	2454	2599	2659	2734	2829	2907	Continuing	Continuing
B74F	Personnel Performance and Training	3028	2872	2778	2952	3132	3218	3328	3419	Continuing	Continuing
B782	Biotechnology Information Facility	0	9865	0	0	0	0	0	0	0	9865

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

Work in this program element is related to and fully coordinated with efforts in PE 0601104A (University/Industry Research Centers), PE 0602120A (Electronic Survivability and Fuzing Technology), PE 0602623A (Joint Service Small Arms Program), PE 0602624A (Weapons and Munitions Technology), PE 0602720A (Environmental Quality Technology) (DA Proj 835 only), PE 0602784A (Military Engineering Technology), PE 0602786A (Logistics Technology), PE 0602787A

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(Medical Technology), PE 0601102A (Defense Medical Sciences), PE 0603105A (Medical Human Immunodeficiency Virus (HIV) Research), PE 0603002A (Medical Advanced Technology), PE 0603807A (Medical Systems-Advanced Development), PE 0604807A (Medical Materiel/Medical Defense Equipment-Engineering Development), PE 0605801A (Program wide Activities, Project MMO2), PE 0605898A (Management Headquarters R & D, Project MMO3), and 0601103D, University Research Initiatives; the Navy, Air Force, and other Department of Defense agencies; National Aeronautics and Space Administration; National Science Foundation; Department of the Interior; Department of Energy; National Bureau of Standards; other Government agencies; and government agencies of Allied nations sponsor related research in areas of this program.

Project AF20 - Advanced Propulsion Research: This project is unique in the Army and DoD, as it is the only 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. The purpose of this project is to perform basic research in propulsion, as applicable to tracked and wheeled vehicles and to rotorcraft. Analysis, code development, tests and evaluations are conducted to improve engine and drive train components and investigate advanced materials. Component level investigations include compressors, combustors, turbines, injectors, pistons, cylinder liners, piston rings, gears, seals and controls. The goal of the activity is increased performance of small airbreathing engines and power trains, to support improvements in system mobility, reliability and survivability.

FY 1994 Accomplishments:

- Performed analysis of advanced alternate engine cycles for ground vehicle application, and developed novel method for determination of fracture toughness of engine ceramics. (398)
- Validated 2D axial-centrifugal compressor model for use in analysis of rotating stall. (498)
- Completed joint Army/NASA/Navy lubrication tests. (200)
- Validated wave rotor Computational Fluid Dynamics codes via splitter cycle experiments. (498)
- Determined influence of matrix creep on fiber load and fatigue behavior of silicon carbide/reaction bonded silicon nitride (SiC/RBSN) composite. (300)
- Designed powder lubricated high temperature bearing, and developed first generation reacting flow combustion code. (547)

FY 1995 Planned Program:

- Identify wear resistant, high temperature ring-liner-lubricant systems for diesel applications. (388)
- Analyze benefit of inserting wave rotor into advanced engine cycles; design 4-port warm cycle wave rotor experiment; validate new transmission diagnostic algorithm; and formulate turbine film cooling code. (1096)
- Incorporate detailed compressor simulation modules into full numerical turboshaft engine simulation, develop surface and interface coatings for SiC/RBSN composites, and design high temp magnetic radial bearing. (789)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (48)

FY 1996 Planned Program:

- Prepare and install large, low-speed centrifugal compressor in test facility for basic flow physics investigation. (396)

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- Complete "reduced chemistry" model for advanced combustor code. (349)
- Complete model of crack propagation in thin rim gears. Complete low noise gearbox validation experiments. (349)
- Complete solid lubrication bearing performance model and design for bench test. (248)
- Complete high temperature fatigue life model, and complete ceramic matrix composite oxidation protection studies. Complete characterization of high-temperature polymer mechanical properties retention. (499)
- Include deformation effects in journal bearing code. Determine best piston ring/cylinder liner tribological pair based on rig tests. (395)

FY 1997 Planned Program:

- Complete diffuser flow field tests for large, low-speed centrifugal compressor. (372)
- Complete carbon deposits/radiation modeling for advanced combustor code. (371)
- Develop analytical tools for low noise face gears. Develop concepts for non-ferrous gears. Validate performance of thin-rimmed, high-speed gears. (459)
- Complete solid lubrication model development. (249)
- Characterize advanced ceramic matrix composite oxidation-resistant coatings. (323)
- Test experimental oxidation-resistant coatings for high-temperature polymers. (149)
- Complete linear stability analysis for finite (with end effects) journal bearing. Include alternative geometries in piston ring analytical model. (449)

Project AF22 - Research in Vehicular Mobility: 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 US 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: the University of Michigan, University of Iowa, University of Wisconsin, Wayne State University, and Howard University, while key industry partners include the three major US automotive manufacturers. In FY 96 and beyond, funding for continued Center of Excellence activity will be transferred to PE 0601104A. In addition to the described Center activity, individual tasks continue to be executed in the overall area of ground vehicle mobility. These individual tasks emphasize state-of-the-art computer simulation and laboratory based modeling of tracked and wheeled vehicles, including unique powertrain and chassis component analysis methodologies. The overall effort develops and demonstrates the theory and methodologies necessary to minimize the need for expensive and time consuming field and laboratory testing of Army ground vehicles.

FY 1994 Accomplishments:

- Researched symbolic and numerical methods to improve real-time vehicle modeling and simulation. (197)
- Interfaced real-time soldier and man-in-the-loop vehicle dynamic models with stationary crew stations. (59)
- Developed theory and procedures necessary to interface real-time vehicle dynamic models with dynamic Crew Station/Turret Motion Base Simulator (CS/TMBS) and Image Generation Systems (IGS). (60)

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- Explored neural network, fuzzy system and genetic algorithm theories to develop on-board intelligent soldier assistant and vehicle accident avoidance/recovery systems. (49)
- Competitively selected University of Michigan to manage the National Automotive Center University Research Initiative Program. (918)

FY 1995 Planned Program:
- Conduct and leverage automotive research through the NAC's Center of Excellence for Automotive Research (2910)
- Perform research in symbolic and numerical methods to improve real-time vehicle modeling and simulation. (150)
- Formulate vehicle/human interface theory methodology including unique real-time feedback (97)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (68)

FY 1996 Planned Program:
- Optimize research in symbolic numerical algorithms which permit accurate, real-time, and cost effective dynamic vehicle simulation (150)
- Refine vehicle/human interface theory to allow accurate phenomena predictability (100)
- Develop vehicle dynamic theory permitting real-time simulation of active control characteristics (75)
- Develop fundamental simulative models for advanced ground vehicle powertrain components (173)

FY 1997 Planned Program:
- Validate symbolic numerical algorithms within real-time vehicle dynamic scenarios (125)
- Enhance numerical computational efficiencies of simulative models describing vehicle/human interfaces (100)
- Demonstrate control algorithms for autonomous neural networks in support of vehicle accident avoidance (100)
- Optimize and validate fundamental simulative models for unique ground vehicle powertrain component combinations (208)

Project BH27 - Research in Munitions Science: Conduct basic research in the areas of explosives, propellants and warhead/penetrator materials in support of future munitions. This research will result in improved performance of chemical/kinetic energy warheads, bio-synthesis/bio-degradation of energetics, increased manufacturing safety and improved battlefield survivability. Beginning in FY 96, funds for this effort are transferred to PE 0601101A. This is consistent with BRAC 91 and the formatic n of ARL, where basic research funding in the RDECs will only be In-House Laboratory Independent Research (ILIR).

FY 1994 Accomplishments:
- Developed computer code to predict sensitivity of explosives to battlefield threats and conducted cooperative R & D agreement for anti-viral, anti-cancer ultra high energy density cubane explosives. (500)
- Established molecular dynamic model of H2N2O2 propellant and conducted baseline tests in 40mm step chamber for the regenerative liquid propellant gun. (1062)
- Characterized advanced tungsten powders and matrix materials to advance tungsten technology for warheads. (290)
- Determined the feasibility of using plant/animal sources to synthesize/degrade energetic materials. (240)

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FY 1995 Planned Program:

- Test and use computer code to identify insensitive high energy explosive. (462)
- Conduct synthesis studies of polynitrocubanes for new ultra high energy density explosives. (470)
- Characterize advanced tungsten composite kinetic energy (KE) penetrators to enhance warhead performance. (331)
- Fabricate a 40mm step chamber test fixture for the regenerative liquid propellant gun. (330)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (35)

FY 1996 Planned Program: Project funded in PE 0601101A

FY 1997 Planned Program: Project funded in PE 0601101A.

Project AH40 - Signals Warfare Laboratory: This project develops the fundamental theory to manage the enormous quantity and variety of tactical intelligence data collected and passed from the Intelligence Electronic Warfare (IEW) battlefield sensors to the battlefield intelligence center. The nature of the problem has necessitated an approach that features an artificial intelligence (AI)-based research for sorting and fusing data from sensors, and signal processing techniques that promote automated sorting and interference reduction at the sensor itself. Beginning in FY 96, funds for this effort are transferred to PE 0601101A. This is consistent with BRAC 91 and the formation of ARL, where basic research funding in the RDECs is to be only ILIR.

FY 1994 Accomplishments:

- Completed theory of data fusion and data fusion concepts; completed algorithms to support a terrain and feature data overlay reasoning system. (236)
- Developed techniques to support 3-D battlefield visualization problems and field-of-view problems; and extended direction finding through ground-based DF system subject to significant multipath effects. (148)
- Extended study of optimal detection of wideband signals; generalized decision theoretic signal classifier work to continuous phase modulated signals. (312)

FY 1995 Planned Program:

- Develop algorithms which will check for algorithm completeness and correctness. (204)
- Develop robust and efficient data base structures which support dynamic procedural language requirements. (200)
- Continue the study of optimal detection of wideband signals to extend to direct sequence spread spectrum. (150)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (12)

FY 1996 Planned Program: Project funded in PE 0601101A.

FY 1997 Planned Program: Project funded in PE 0601101A.

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Project AH42 - Materials and Mechanics: This project establishes the science base for creating and producing advanced materials to achieve higher performance, lower cost, improved reliability and environmental compatibility for Army-unique system and component applications. Emphasis is on synthesis, processing and understanding fundamental aspects of chemistry and microstructure that influence the flow and failure mechanisms of materials subjected to high strain rates (armor/anti-armor); the permeation and performance characteristics of materials subjected to chemical, biological and directed energy threats; and the durability, service life and maintenance of candidate materials for ground combat vehicles, armament systems, personnel support and aircraft. Research at university Centers of Excellence will complement in-house research in materials science.

FY 1994 Accomplishments:

- Determined shock response of glass reinforced plastic (GRP) armor, and characterized tungsten alloys. (763)
- Completed studies on use of molecular dynamics simulations to predict interactions at adhesive adherent interface. (450)
- Demonstrated the joining of similar/dissimilar ceramic materials for ambient and high temperature use, and demonstrated ion beam technique to improve wear and corrosion resistance of rotary winged aircraft components. (659)
- Developed mathematical model describing effect of chemical agents on protective material, and optimized radar parameters of most promising neural-network architectures for a mine detection radar system. (744)
- Developed research and development linkages with universities in the Aberdeen, Maryland area. (984)
- Extended kinematic viscoelastic model for rubber to composite laminates (284)

FY 1995 Planned Program:

- Measure shock induced damage in armor materials under combined compression/shear shock loading. (585)
- Develop joined ceramic component for testing at high temperatures. (800)
- Optimize dry ion beam treatments as environmentally acceptable alternatives to cadmium/chromium electroplating, and optimize surface treatments to reduce hydrogen embrittlement of high strength armor steel. (432)
- Demonstrate computer simulation of chemical agent molecular permeation through organic barrier. (865)
- Establish materials Center of Excellence with local universities. (3000)
- For selected neural network algorithms, use mine data to evaluate effectiveness and robustness. (419)
- Improve NASA's aircraft tire modeling capability by adding viscoelasticity to the finite element models and predict strength of thick curved laminates and perform quasi-static testing (247)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (136)

FY 1996 Planned Program:

- Synthesize and characterize bulk ferroelectric composites for phased array antenna applications. (777)
- Determine shock induced damage in armor materials under oblique impact/shock. (318)
- Correlate hydrogen bonding energies with microstructural constituents in high strength steels intended for aviation and armor use. (356)

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- Include thermal and anisotropic effects in new constitutive models for elastomer structures. (146)

FY 1997 Planned Program:
- Establish the science base for creating and producing special function electrical, magnetic, optical, chemical-biological protective, and smart-responsive materials. (780)
- Provide a clear and correct understanding of the relationship between microstructure and mechanisms of flow and failure in materials subjected to high strain rates typical of armor/anti-armor events. (534)
- Provide an understanding of the structure and properties of metal, ceramic, polymer, composite and hybrid materials surfaces and interphases to improve performance and long-term durability. (399)
- Investigate computational difficulties associated with simulating manufacturing of composite structures made with elastomers, and develop criteria for failure and fatigue durability of thick curved laminates. (172)

Project AH43 - Research in Ballistics: This project contains research on combustion chemistry, physics and fluid dynamics, physics of explosive materials, interior ballistic reaction kinetics, computational algorithms, computer networking, and remote sensing.

FY 1994 Accomplishments:
- Exploited the shaped-charge jet necking phenomena toward creation of segmented shaped-charge penetrator. (656)
- Computationally simulated the interior ballistics of a liquid propellant gun. (1153)
- Generated variable resolution terrain data to model existing digital topographic data. (1270)
- Validated in a hydrocode a brittle/ductile damage model for high-pressure, small-elastic-distortion ballistic environments. (1011)
- Demonstrated passive infrared tracker, and developed families of error control codes for error free transmission across shared channels. (1254)

FY 1995 Planned Program:
- Explore novel techniques to extend penetrators in flight and provide a shaped charge precursor for a Kinetic Energy (KE) rod. (930)
- Integrate multiple infrared (IR) tracker systems to perform real-time tracking and interception of threat munitions for an active protection system. (704)
- Identify/explore potential countermeasures to electromagnetic armor, and integrate natural and man-made surface features into complete scene with variable resolution terrain model. (1748)
- Improve the code designs obtained in FY 1994 to boost code transmission rates to channel capacity and develop three dimensional simulation of solid propellant electrothermal chemical with next generation ballistics code. (1682)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (108)

FY 1996 Planned Program:
- Formulate liquid propellant jet breakup and combustion algorithms applicable to the high pressure regime in guns. (1154)

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- Conduct interior ballistic simulations of a granular solid propellant at high initial loading density and subjected to external (e.g., plasma) energy addition; assess its combustion stability. (596)
- Extend current models of non-steady rod penetration to include length/diameter (L/D) effects and demonstrate utility by comparing with penetration over a range of L/D values. (879)
- Incorporate infrared tracker with signal processing module in real-time range demonstration of counter-kinetic energy components. (615)
- Demonstrate fusion of topographic, navigational sensor and optical data to form a cohesive system for navigation. (309)
- Investigate collateral effects of Electromagnetic (EM) environments from pulsed power sources and EM guns and systems on host vehicles, personnel and on other nearby assets. (831)
- Investigate the stability of channel access protocols in which adaptive coding techniques are employed. (393)
- Investigate means for describing the texture and correlations of Millimeter Wave (MMW) clutter through the analysis of data collected using a multi-frequency MMW rail synthetic aperture radar. (282)

FY 1997 Planned Program:

- Develop submodels of the surface and subsurface physics and chemistry of nitramine composite propellants which account for oxidizer particle-size dependence on burning rate. (1030)
- Develop a finite element model capable of computing the transverse loads and accelerations imparted to sensitive projectile guidance and control components while inside a gun tube. (866)
- Develop a simple analytical model for ceramic armor elements, including the dwell phenomenon, using a minimum of model-based parameters. (952)
- Exploit theoretical and experimental capabilities to develop EM armor scaling relationships. (1001)
- Validate coupled aero-loading/response code against experimental data on vehicle response to blast loading. (834)
- Exploit trellis-coded modulation for data communication over narrowband military voice channels. (393)
- Investigate coherent and non-coherent super-resolution techniques in scenes with distributed clutter. (282)

Project AH44 - Advanced Sensors Research: This project exploits new opportunities in the basic sciences underpinning the technological areas of: signal and image processing by both digital and optical techniques; radar; and smart sensors. Research involves fundamental science and engineering principles that support survivable sensor systems for target recognition. Monolithic and hybrid optoelectronic structures in gallium arsenide and lithium niobate are investigated as integrated processors for novel signal and radar processing. Diffractive optics is investigated to enhance the performance of bulk and integrated optical processors. Processing algorithms and architectures are investigated for performance of bulk and integrated optical processors. Processing algorithms and architectures are investigated for electromagnetic sensing and imaging of ultra-wideband, inverse, and conventional synthetic aperture radar (SAR) returns.

FY 1994 Accomplishments:

- Applied wavelet transform techniques to target recognition of militarily significant target vehicles in ultra-wideband radar return signatures. (156)

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- Designed, fabricated, and tested the thermal and optical properties of single material hybrid diffractive-refractive athermal lenses, and of two material hybrid athermal, achromatic lenses. (369)
- Characterized the performance of devices for integrated photonic processors: surface acoustic wave (SAW) transducers; embedded waveguide lenses in gallium arsenide; and outcoupling gratings in gallium arsenide and titanium-doped lithium niobate. (369)
- Improved SAR automatic target recognition algorithms, and researched optically integrated signal processing devices. (837)
- Developed low threshold vertical cavity surface emitting laser devices, and determined electrical breakdown characteristics, of a variety of silicon carbide semiconductors. (993)

FY 1995 Planned Program:

- Integrate refractive, diffractive, and/or integrated optical elements for performing image processing. (579)
- Research integrated photonic devices for control of phased-array antennas. (1040)
- Design a photonic-based system for implementing algorithms using cyclic spectra. (237)
- Demonstrate prototype two-dimensional spatial light modulators for optical signal processing applications. (290)
- Demonstrate semi-insulating silicon carbide substrates by appropriate introduction of deep level impurities. (427)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (56)

FY 1996 Planned Program:

- Design, construct and characterize optical processors for image and signal processing, incorporating refractive, diffractive and/or integrated optical elements. (312)
- Continue research on components for optical control of microwaves by combining integrated optic beam splitter with phase modulators and amplifier structures. (285)
- Construct and characterize photonic fourth-quarter FY 1996 implementations of cyclic correlation algorithms. (133)
- Demonstrate hybrid integrated smart pixel employing vertical cavity surface emitting lasers for 2D optical processing, image processing, and neural nets for aided target recognition. (717)
- Investigate ferroelectric/field effect transistor (FE/FET) approaches to developing simple memory cell designs for very high density non-volatile memories. (295)

FY 1997 Planned Program:

- Incorporate on-chip processing and optical pre-processing on two dimensional photodetector arrays for improved performance and functionality. (354)
- Design photonic based integrated optic processor for optical control of microwaves and phased arrays. (301)
- Research photonic implementations of automatic target recognition (ATR) and other signal processing algorithms. (142)
- Demonstrate high density hybrid smart pixel array employing vertical cavity surface emitting lasers for 2D optical processing, image processing, and neural nets for aided target recognition. (781)
- Apply the giant magnetoresistive (GMR) effect to non-volatile memory design. (319)

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Project AH45 - Air Mobility: Basic and applied research in aerodynamics and avionics as applied to rotary wing aircraft. Analysis, code development, test and evaluation are conducted on rotor unique aerodynamics, dynamics, performance, and aircraft performance and acoustics. Efforts in avionics are focused in antenna modeling and advanced display concepts.

FY 1994 Accomplishments:
- Designed smart material model rotor and fabricated dynamic stall-free airfoils with slats; and conducted advanced rotor aeroacoustic tests under helicopter acoustic rotor test (HART) program. (689)
- Incorporated improved turbulence models into Euler codes; validated interactional aerodynamic analysis with test data. (492)
- Fabricated advanced dynamic model hub and blades, and completed hover tests. (1132)
- Modified Hughes advanced rotor program (HARP) code for non-metallic or composite helicopters; transitioned code to Silicon Graphics workstation. (572)

FY 1995 Planned Program:
- Fabricate smart airfoil models and dynamic stall-free experimental model rotors. (594)
- Investigate new blade concepts for low noise and vibration characteristics; and validate computational aeroacoustic codes for blade vortex interaction. (1025)
- Evaluate antennas embedded in composite tail rotor by both electromagnetic modeling and measurements. (431)
- Initiate interactional aerodynamics studies with the isolated rotor test system (IRTS) experimental system. (99)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (46)

FY 1996 Planned Program:
- Test and evaluate smart airfoils and stall-free model rotors. (721)
- Investigate rotor active control techniques for acoustic propagation. (517)
- Conduct interactional aero-vibration code validation focused studies. (522)
- Extend antenna codes to handle multiple composite materials. (274)

FY 1997 Planned Program:
- Expand smart airfoil results to revolutionary envelope expansion for rotorcraft. (1013)
- Initiate the combination of aeroacoustic theory with interactional aero computational fluid dynamics (CFD) codes. (1204)

Project AH47 - Applied Physics Research: The purpose of this program is to perform research on critical optoelectronic hybrid components, power sources, fuel cells, microsensors, photonics, magnetics and experimental nanofabrication processes vital to supporting Army requirements in the areas of electronic warfare (EW), reconnaissance, surveillance, target acquisition (RSTA); and fire-and-forget munitions. This project exploits emerging technologies and develops needed device concepts for: smart tactical electronics for real-time signal/data processing in tactical scenarios; millimeter-wave technologies for mini-radars (motor vehicle collision warning devices), missile seekers (thermal heat leakage from home/factories), and secure communications (business/banking); and ultra-long-life batteries for a wide variety of

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man-portable equipment. A Center of Excellence will be established at local universities to support dual-use research in opto-electronic components, ultra-low power electronics, uncooled, and low-cost/compact night vision components.

FY 1994 Accomplishments:

- Demonstrated prototype gallium arsenide(GaAs) operating at a twelve micrometer wavelength. (935)
- Developed process for thick, low-stress silicon nitride for micromachined devices structures. (561)
- Developed spin-on sol gel process for fabrication of thin-film ferroelectric phosphide (PZT). (689)
- Developed process technology and demonstrated microscale microphone with ferroelectric transducer. (967)
- Demonstrated growth of lattice-matched indium gallium arsenide/indium aluminum arsenide (InGaAs/InAlAs) on indium phosphide (InP). (663)
- Developed prototype single-pixel 12-micron detector chip for NASA atmospheric temperature measurement and satellite detection. (689)
- Increased ionic conductivity of polymer electrolytes for solid state lithium battery. (551)
- Initiated program to develop improved catalyst for methanol fuel cell. (197)
- Initiated program to develop new proton exchange membrane for fuel cell for microclimate cooling. (280)
- Prepared for establishment of university Center of Excellence in Electronics. (985)

FY 1995 Planned Program:

- Design, fabricate, and test 128x128 focal plane array (FPA) multicolor infrared (IR) detector in GaAs. (1435)
- Develop a process for depositing and etching single crystal germanium waveguides on GaAs wafers with application to optical computing and phase array radar. (1245)
- Fabricate and test a microscale fluidic laminar proportional amplifier for low-cost high performance acoustic sensors. (815)
- Develop materials and processes for the fabrication of SiC and diamond high power photoconductive semiconductor switches for ultra wideband radar. (805)
- Formulate compatible high-energy cathode materials for rechargeable lithium (Li)/polymer solid-state battery. (525)
- Formulate multi-component electrocatalyst for low over voltage methanol oxidation catalyst. (240)
- Evaluate dehydration resistance of proton exchange membrane (PEM)s for fuel cells. (205)
- Establish university Center of Excellence in Electronics. (2875)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (174)

FY 1996 Planned Program:

- Demonstrate integrated loss-less optical splitter/phase shifter necessary for lightweight, low cost highly functional integrated photonic devices critical to Army communication-on-the-move systems, and for fiber optic gyroscopes for missile guidance and global positioning. (835)
- Design and demonstrate tunable multicolor quantum well infrared photodetector (QWIP) to provide high performance, low cost and highly manufacturable technology with unique capabilities for DoD and NASA's infrared imaging requirements. (722)
- Develop spatial light modular array for implementing fast optical processing architectures for automatic target recognition applications, as well as excellent candidates for dual use. (696)

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- Demonstrate prototype rechargeable Li battery with high conductivity polymer electrolyte and compatible high energy cathode. (400)

FY 1997 Planned Program:

- Demonstrate integrated photonic laser/shifter/receiver to extend capabilities of Army communications systems for a digitized battlefield and for fiber optic gyroscopes for missile guidance and global positioning. (1193)
- Transfer tunable quantum well infrared photodetector (QWIP) technology to DoD and NASA. (945)
- Design and demonstrate fully addressable smart pixel array to provide high speed, high resolution components for implementing fast optical processing architectures for automatic target recognition applications, as well as excellent candidates for dual use. (505)
- Develop and demonstrate initial field prototypes of man-portable methanol fuel cells with a potential 3X increase in energy density compared with lithium primary batteries for 21st Century Land Warrior (21 CLW). (400)

Project AH48 - Communications Research: Two directorates of the U.S. Army Communications-Electronics Command (CECOM) perform basic research under project AH48: the Space and Terrestrial Communications (S & T Comm) Directorate and the Command, Control, and Systems Integration (C2SI) Directorate. The research mission of these directorates is to provide the basic technology needed for the development of advanced C3 equipment and systems for the digitized battlefield. Specifically, SandT Comm addresses research issues in the areas of network management and control, antennas and propagation, and fiber optics and photonics. C2SI conducts research in the fields of artificial intelligence and modeling of C2 systems.

FY 1994 Accomplishments:

- Developed advanced design and fabrication techniques for integrated photonic subsystems. (307)
- Investigated formal, fully automated techniques of multi-media protocol composition/decomposition for network management and control. (205)
- Continued participation in EUROCAP program on characterization of ionospheric high frequency (HF) propagation conditions over a wide geographical area. (313)
- Developed computationally efficient synthesis procedures for printed phased arrays, including equivalent circuit models for transitions in (printed) feed system. (330)
- Designed integrated decision-aids demonstration program. (524)
- Developed common language for C2 that enables the development of object-oriented C2 system models. (196)

FY 1995 Planned Program:

- Continue development of photonic technology for optically fed/controlled phased arrays. (248)
- Continue research on formal techniques of protocol engineering. (260)
- Investigate propagation prediction techniques for tactical radio communication at frequencies in the wireless personal-communication band. (165)
- Continue development of advanced numerical analysis methods for printed antennas/arrays. The goal is a highly efficient user-friendly computer code. (85)
- Continue studies on representation of a battlefield situation that supports automated plan management and on object oriented C2 system modeling. (295)
- Research AI techniques for design of distributed decision support applications for integration into Army tactical C2 systems. (397)
  Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (12)

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FY 1996 Planned Program: Project funded in PE 0601101A.

FY 1997 Planned Program: Project funded in PE 0601101A.

Project AH49 - Research in Missiles and High Energy Lasers: This is the only Defense Research Sciences project providing basic research dedicated to the development and evaluation of evolving science knowledge critical for future superiority in Army missiles and high energy lasers. Current research emphasis is in selected key areas: integrated and guided-wave optics; optical pattern recognition; quantum optics; neural network applications; signal processing/analysis; electro-optical materials. Work in this project supports PE 0602303A and PE 0602307A at Missile Command RDEC and is fully coordinated with related activity at the Army Research Laboratory (ARL).

FY 1994 Accomplishments:

- Developed optical correlator technology for smart weapons applications in target cueing, and exploited neural network computing techniques in aided target cueing. (1537)
- Conducted integrated and guided wave optics research for sensors and signal processing circuits. (924)
- Investigated quality assessment techniques for optical and electronic materials which are nondestructive and suitable for in-situ applications. (713)
- Conducted research in quantum and nonlinear optics for future opto-electronic components and optical computing systems. (704)

FY 1995 Planned Program:

- Exploit advantages of neural network computing techniques for aided target recognition and cueing, and conduct integrated and guided wave optics research enabling improved fabrication/packaging for sensors. (1120)
- Demonstrate optical correlator technology for smart weapons applications in target recognition and cueing and missile terminal guidance. (1297)
- Develop advanced integrated and opto-electronic optical components and structures enabling exploitation of photonic devices for missile target acquisition, discrimination and tracking. (684)
- Conduct research in quantum and nonlinear optics for future opto-electronic components and optical computing systems. (332)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (29)

FY 1996 Planned Program: Project funded in PE 0601101A.

FY 1997 Planned Program: Project funded in PE 0601101A.

Project AH51 - Combat Support: Basic research in fuels and lubricants involving lubrication tribology investigations is performed by Army scientists collocated at Wright Laboratory (USAF) under Project Reliance. Also under this project, the Materials Directorate of the Army Research Laboratory (ARL) performs basic research in elastomers, low volatile organic compounds (VOC) Chemical Agent Resistant Coating (CARC) with low observability in the extended infra-red region. Beginning in FY

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96, funds for this effort are transferred to PE 0601101A. This is consistent with BRAC 91 and the formation of ARL, where basic research funding in the RDECs is to be only ILIR.

FY 1994 Accomplishments:
- Studied the effect of composition, stress and weathering on the abrasion resistance of polymeric materials, using various abrasion measuring instruments. (179)
- Evaluated higher frequency and wider bandwidth detection radars for near-surface mines, and investigated the effect of electron donating additives on the stability of explosives. (372)
- Evaluated various neural-network architectures and models to improve accuracy of mine detection, and investigated surface chemistry/coatings process variables. (417)

FY 1995 Planned Program:
- Define load-carrying capability of solid lubricant-metal combinations (136)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (3)

FY 1996 Planned Program: Project funded in PE 0601101A.

FY 1997 Planned Program: Project funded in PE 0601101A.

Project AH52 - Equipment for the Soldier: Basic research focused on five core technology areas critical to the Soldier System: biotechnology, polymer science/textile technology, food technology, airdrop technology, and behavior/performance science. Research is targeted toward enhancing the mission performance, survivability, and sustainability of the soldier by advancing the state of the art in defense against battlefield threats and hazards such as ballistics, chemical agents, lasers, environmental extremes, shortage of potable water supplies, and shortfalls in the availability of nutritious, satisfying rations essential to the health and well-being of soldiers. Beginning in FY 96, the research will focus on only the first three of these five technology areas.

FY 1994 Accomplishments:
- Synthesized thermally processable polymers/kevlar-like copolymers for ballistic protection of vests; determined impact failure mechanisms for composites for lighter weight ballistic protective vests and helmets (987)
- Demonstrated that the liposome cargo in both plasma and lymph systems was present; however the intact liposome uptake was limited (530)
- Identified conditions for liquid crystal phase formation to spin protein fibers from silk; demonstrated assembly of protein based nanostructures leading to new materials designs for ballistic/chemical defense (760)
- Enhanced structural model for aeroelastic parachute opening problem prediction (166)

FY 1995 Planned Program:
- Determine relationship between mechanical properties (viscoelasticity) and performance of ballistic penetration resistant yarns, fiber, and composites (225)

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- Investigate modified liposomes and stabilized micelles as carriers for bioactive food amino acids; generate first level interaction in self-assembling protein-based materials; and construct database of human performance measures (250)
- Produce first generation silk-based protein fibers for lightweight protection (350)
- Spin fibers from newly developed copolymer materials to be used for personnel armor; transition to 6.2 (275)
- Develop means of predicting protective ability of chemical defense materials by combining fractal dimensions with atomic force microscopy (222)
- Use enzyme based polymerization process for synthesizing optical and electronic application materials for laser eye protection (135)
- Use electro-chemical polmerization methods to develop smart materials for signal transduction (140)
- Predict behavior of parachutes changing shape as they open (175)
- Determine the extent of metabolism of bioactive proteins for oral delivery of performance enhancing nutrients (121)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (41)

FY 1996 Planned Program:

- Optimize silk fibers for transition to ballistic protective materials applications (130)
- Investigate thin-film technologies to demonstrate self-assembling for controlled permeation (125)
- Determine the physical properties of newly modified polymers for ballistic applications and measure ballistic performance using novel mechanics testing. (348)
- Establish data base on chemical protection materials through correlations of fractal dimensions and atomic force microscopy (138)
- Investigate chemical marker formation in foods to identify processing variables for improved processing technologies. (140)
- Demonstrate reproducible yields of chemical markers for food systems processing (110)

FY 1997 Planned Program:

- Establish theoretical framework using ballistic fiber property data for designing optimum ballistic penetration resistant structures. (410)
- Investigate mechanism of charged biopolymers for application as biodegradable edible barriers (160)
- Establish mechanisms for improved processed food quality by determining processing parameters of food produced using novel techniques. (243)
- Incorporate self-assembly technologies into newly developed ballistic silk fibers for further refinement of properties and characteristics (205)

Project BH57 - Scientific Problems with Military Applications: This extramural research project seeks to capture and exploit new scientific opportunities and technology breakthroughs, primarily at universities, to improve the Army's future operational capabilities. The Army Research Office maintains a strong peer-reviewed scientific research program through which technological improvements to warfighting capability can be assessed and implemented. Included are research efforts of scientific study and experimentation directed toward increasing knowledge and understanding in fields related to long-term national security needs and covering the physical sciences (physics, chemistry, biology, and mathematics) , the engineering sciences (mechanicanics, electronics, computer, energy conversion, aeronautics, and materials), and the environmental sciences (atmospheric and terrestrial). It covers approximately 450 grants and contracts with leading academic researchers and over 800 graduate students yearly, and supports research at over 150 universities in 41 states. Additionally, 5% of Army funding of universities research is committed to Historically Black Colleges and Universities/Minority Institutions (HBCU/MI). In FY 1996 the High Performance Computing Research Center of Excellence (COE) and

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the Information Sciences COE will transition to the Army Research Laboratory (ARL). Other COEs are restructured from Project BH57 into PE 0601104A, Project BH59 in FY 1996.

FY 1994 Accomplishments:

- Advanced state-of-the art in atmospheric science research by using a ultra-high frequency (UHF) radar system with high temporal resolution for determining boundary layer properties, by means of a turbulence eddy profiler. (8226)
- Advanced biosciences research by developing a new molecular genetics method providing the capability to modify biomembranes with the potential for self-assembly into higher order structures biomaterial. (7881)
- Advanced electronics research into the integration of a complete millimeter wave monopulse receiver on a chip which is capable of tracking targets without the use of external components. (8260)
- Invented fractal sol-gel coating for aluminum which improves the protection of treated surfaces from salt corrosion by a factor of 100. (7403)
- Advanced computer science research by development of a new 3-D visualization software tool which allows a large medical data-set image to be rotated, panned and zoomed in real-time. (9679)
- Advanced mechanics research at the three Rotorcraft Technology Centers of Excellence by combining adaptive structures with output feedback and state observer controllers to produce robust algorithms for rotor blades control. (9510)
- Advanced physics research by applying newly invented photonic crystals that exclude all electromagnetic radiation over a band of frequencies to the monolithic microwave integrated circuit (MMIC)-base planar antenna performance. (5763)
- Demonstrated use of supercritical water to carry out environmental research on hydrolysis and oxidation of cellulosic waste. Created a new nitrogen containing carrier with three times the ability, over today's commercial agents, to extract copper from its ores. (4925)

FY 1995 Planned Program:

- Advance physics research to develop tunable laser sources for applications utilizing nonlinear optical processes for sensor protection and remote sensing (9825)
- Advance mechanics research focusing on electromagnetics and physical constraints, and shock-induced changes in materials for survivable resilient structures (9400)
- Advance research in electron modes of operation that will result in low power consumption devices which can operate in high temperature (9046)
- Exploit materials research including bonding of complex adhesive polymers through electron holography (7930)
- Advance chemistry research including applying superlattice technology to thermoelectric materials for major innovations in cryo-cooler design which could lead to improved infrared detectors and new commercial applications (7020)
- Initiate joint terrestrial and atmospheric sciences program to model non-linear geophysical flows in the natural environment for improved all-weather, all-terrain operations (3650)
- Advance bioscience research in genetically engineered polymers containing non-natural amino acids, using cellular biosynthetic machinery, to create new protein-based materials (3373)
- Develop more robust mathematical models for the design of novel composites (5930)

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- Exploit investigations of electron transport of mercury cadmium teleride semiconductors using Monte Carlo calculations to improve infrared focal plane array technology (6000)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (1199)

FY 1996 Planned Program:

- Advance atmospheric sciences research to explore stable boundary layer physics, field testing of atmospheric models and remote sensing of 3-D boundary layer (3365)
- Advance biosciences research to develop microbiological and biochemical characterization of cells to break down military materiel waste (3089)
- Advance research in mesoscopic electronic systems and nanostructures for ultrafast information processing for command and control applications (9535)
- Investigate novel approaches for modifying the properties of structural materials through tailoring of ceramics, polymers and composites (7850)
- Design adaptive intelligent control systems for multivariable and nonlinear systems with application to real-time implementation in embedded systems (8975)
- Develop "smart" structures concepts to suppress vibrations, reduce noise levels, and modify structural shapes of rotorcraft (7850)
- Develop techniques for coherent infrared imaging, millimeter wave imaging, multiple wavelength detectors and temporal imaging to improve visibility (7850)
- Advance research in electrochemistry in areas of electron transfer, electro-oxidation, and electrocatalysis to provide mobile energy source improvements (7570)

FY 1997 Planned Program:

- Advance materials research in Kevlar ionomeric blended composites which have the toughness of polymer composites without loss of optical properties (8240)
- Advance research in mechanics to demonstrate a time-dependent, 3-D model of fuel injection, ignition and combustion dynamics to identify optical ranges of engine operation (8240)
- Advance electronics research to produce high quality, highly doped semiconductor films for blue/green light emitting devices for optoelectronic devices and displays (10000)
- Advance biosciences research including deriving a novel photochromic material from bacteriorhodopsin (3249)
- Advance research in chemistry to create a new synthetic route to recyclable polymers with tailored properties (7950)
- Advance computer science research to design a multi-protocol for the integration of symbolic, numeric, graphics and document processing into a single problem-solving environment (9420)
- Explore nonlinear optical phenomena occurring in liquid crystal optical fibers for possible application for pulse compression, frequency conversion and other electro-optical applications (8240)
- Advance atmospheric sciences research including discovery of the physics that underlay backscattering enhancement from very rough and very smooth surfaces (3530)

Project AH60 - Research in Armaments: This project contains basic research in the areas of smart projectiles, autonomous launchers, and fire control systems. Efforts focus on resolving basic technology problems required for insertion into Exploratory Development and Advanced Technology Development.

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FY 1994 Accomplishments:

- Prepared waveguide detector structures via Molecular Beam Epitaxy (MBE) and integrated into prototype devices for initial evaluation of increased signal processing speed and volume. (609)
- Implemented neural networks into a speech recognition module for smart projectiles to recognize large vocabulary sets in the presence of noise, with real-time constraints. (611)
- Developed target recognition algorithms which are terrain adaptive and expanded the terrain database for application to multimode seekers (infrared (IR) and laser radar (LADAR). (600)

FY 1995 Planned Program:

- Evaluate and select optimum waveguide processing device concepts and prepare conceptual designs. (300)
- Complete the development and evaluation of laboratory prototype voice recognition and synthesis module capable of real-time functioning in the presence of complex noise. (300)
- Develop signature and signal modeling simulation workstation for cost effective evaluation of laser radar sensor algorithms. (299)
- Investigate planar optical approaches to large processor gain correlation for high bandwidth radar. (234)
- Investigate discourse processing aspect of natural language for human-computer interface for on-the-move command and control. (125)
- Develop a design procedure for low cost electronic scan antennas. (125)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (11)

FY 1996 Planned Program: Project not funded in FY 1996.

FY 1997 Planned Program: Project not funded in FY 1997

Project AH61 - Research in Close Combat Weaponry: This effort addresses basic physical phenomena associated with gun armament development and applies the knowledge gained to new design approaches to extend service life and improve the accuracy and life cycle cost of weapon systems. Additional efforts involve the prediction of the dynamic effects in weapon and ammunition components, deposition and high strength refractory metals and alloys and characterization of weapon system failure mechanics. Efforts focus on resolving basic technology problems required for insertion into Exploratory Development and Advanced Technology Development. This project supports Science and Technology Thrusts for Advanced Land Combat. Beginning in FY 96, funds for this effort are transferred to PE 0601101A. This is consistent with BRAC 91 and the formation of ARL, where basic research funding in the RDECs will only be ILIR.

FY 1994 Accomplishments:

- Incorporated fractal/multi-fractal analysis methods to characterize material surfaces damaged by fracture, wear and erosion. (356)
- Evaluated cylindrical magnetron sputtering system and improved the uniformity of the plasma within the cylindrical field to improve coating resistance to temperature and pressure. (374)

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- Tested new design obturator for attenuating gun tube dynamic strains. (335)
- Developed techniques for simulating fatigue life analysis of eroded gun tubes. (285)

FY 1995 Planned Program:
- Establish combined neural net multifractal method characterizing material microstructures to resolve gun material problems. (244)
- Evaluate gun materials prepared with planar magnetron and cylindrical magnetron sputtering systems for future coatings applications. (254)
- Enhance muzzle brake computer code by chemistry integrated model of propellant gases to optimize projectile obturator designs. (262)
- Establish new test geometry for use in gun failure predictions in accordance with the American Society for Testing and Materials fracture toughness standards. (249)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (22)

FY 1996 Planned Program: Project funded in PE 0601101A.

FY 1997 Planned Program: Project funded in PE 0601101A.

Project AH66 - Advanced Structures Research: As agreed to under Project Reliance, this is the only project for rotorcraft and ground structures basic research within the DoD. The purpose of this project is to perform basic and applied research in structures, as applied to rotorcraft and ground vehicles. No related effort is being conducted within DoD.

FY 1994 Accomplishments:
- Evaluated structure-borne noise reduction levels using an active helicopter transmission mount. (233)
- Incorporated specimen-geometry related failure mechanisms in existing failure theories to predict strength of full scale crashworthy structures. (158)
- Jointly modeled Learfan 2100 section drop tests under a U.S./German Memorandum of Understanding (MOU) in composite crashworthiness. (238)
- Developed analytical capability in area of tilt-rotor aircraft using comprehensive analytical model of rotorcraft aerodynamics and dynamics II (CAMRAD II), 2nd generation comprehensive helicopter analysis system (2GCHAS) and other computer models. (158)
- Extended delamination analysis for tapered laminates to specific rotorcraft hub configurations under Cooperative Research and Development Agreements (CRDA)s with Bell Helicopter and McDonnell Douglas Helicopter Company (MDHC); developed low velocity impact test methodology. (437)
- Evaluated neural network systems for processing thermal corrosion data for automated inspection methods. (202)

FY 1995 Planned Program:
- Test piezoelectric elements bonded to a liner inside a composite cylinder for active control of interior noise, and validate Nearfield Acoustical Holography (NAH) techniques in a simple enclosure. (218)
- Carry out detailed stress analysis to isolate specimen edge effects, investigate scaling effects under complex statically applied loads, and jointly model the full-scale crash test of the Learfan 2100 under a U.S./German MOU. (376)

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- Complete aeroelastic model test of composite tailored tiltrotor "thin" wing design in the Transonic Dynamics Tunnel, and initiate refurbishment of tiltrotor model power train system to enable power-on testing. (145)
- Conduct tests to validate delamination criteria for rotorcraft composite hub designs being worked under CRDAs with Bell and MDHC. (243)
- Develop low velocity test methodology and standard impact test based on quasi-static test method. (145)
- Develop hybrid technique for processing thermal non-destructive evaluation data and incorporate into a prototype thermal instrument. (207)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (28)

FY 1996 Planned Program:

- Conduct a comprehensive test to characterize damage development in scaled composite tensile coupons at intermediate tension levels using x-ray techniques, and evaluate the use of real-time continuous x-ray methods. (200)
- Conduct crash tests of a Learfan 2100 fuselage with and without modified energy absorbing subfloor. (379)
- Build a structurally tailored rotor blade system, designed to improve tilt rotor aeroelasticity stability for the tilt rotor model in the NASA Langley Transonic Dynamic Tunnel (TDT). (144)
- Validate 3D finite element analysis (FEA) for predicting delamination onset in tapered laminates under combined tension-bending loads; document damage tolerance design criteria for low velocity impact damage; validate advanced p-version FEA. (470)
- Investigate artificial intelligence (AI) pre/post processing science for applications to advanced non-destructive evaluation (NDE) methods. (109)

FY 1997 Planned Program:

- Develop an improved analytical model for predicting the size effect on strength for advanced composite materials. (402)
- Use Vlasov analysis with optimization algorithm to study how to design more efficient energy absorbing fuselage frames specifically looking at the effect of tapered beam cross sections. (212)
- Conduct validation tests of the structurally tailored tilt rotor system in the NASA Langley TDT. (153)
- Develop improved analyses for predicting onset and progression of damage in woven and braided composites; transition advanced stress analysis methods to 3D woven composite structures. (347)
- Develop advanced NDE technology to integrate sensors and AI for enhanced structural integrity monitoring. (130)
- Analyze and evaluate advanced computational science methods for error detection and adaptive mesh refinement. (137)

Project BH67 - Environmental Research - Army Materiel Command: This project focuses basic research on technologies for pollution prevention related to Army Materiel Command materiel development programs. The objectives are to: establish a technology base for pollution prevention and life cycle management of hazardous materials and wastes; develop innovative key technologies to reduce the cost and risk of the Army's environmental challenge. Program 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; ordnance 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

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conversion coatings for metal and composite surfaces. This program is linked to the Tri-Service Environmental Quality R & D Strategic Plan and addresses environmental technology requirements addressed in that plan.

FY 1994 Accomplishments:

- Established and optimized the bioconversion of a nitrocellulose (NC) based gun propellant; developed a new environmentally friendly synthesis of trinitrotoluene (TNT). (594)
- Solicited, via a Broad Agency Announcement, projects from academia/industry to establish a Technology Base for pollution prevention. Proposals to be evaluated and selected for funding in FY 95. (2145)
- Identified target materials for aqueous processing. Identified and selected biological surfactants for aqueous based degreasing and isolated lightweight protective ceramics. (352)
- Measured ultraviolet (UV) cross-section of candidate halon replacement CF3I according to temperature; measured reactions of halogenated peroxyl radicals with alkenes. (217)
- Measured gaseous and condensed products for standard propellant types (M30, JA2, M43) burned in air. (222)
- Initiated laboratory plant uptake investigations for chemical warfare agents and munition compounds and developed soil fauna microcosms. (213)
- Established hepatic and neuronal cell lines and initiated validation of cytosensor (LAPS microphysiometer) method for predicting toxicity in humans. (87)
- Performed preliminary microbial enrichment studies to determine feasibility of complete destruction of hydrolyzed, munitions-grade mustard (HD). (470)

FY 1995 Planned Program:

- Establish the feasibility of explosive composition bioconversion and explore a second new environmentally friendly trinitrotoluene (TNT) production method. (1994)
- Initiate aqueous processing of membrane structures, optimize processing for aqueous based degreasing and explore biomimetic processes for lightweight protective ceramics application. (1230)
- Measure photochemical properties (primary decomposition products/branching ratios) of halon alternative compounds (HACs), and thermal (non-photochemical kinetics) for HAC decomposition products. (769)
- Fabricate propellants containing DENOx additives; measure atmospheric pressure combustion products; measure burning rate, flame structure and combustion products in strand burner vs. pressure. (769)
- Initiate controlled plant studies and test terrestrial microcosm sensitivity. (1135)
- Assess toxicity of militarily significant environmental pollutants in human cell lines and compare to published values. (277)
- Identify enzymatic pathway for hydrolyzed mustard metabolism and clone genes for several G-agent degrading enzymes. (1253)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (160)

FY 1996 Planned Program:

- Apply genetic engineering techniques to both synthesis and bioconversion applications as a means for process optimization. (1555)

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- Complete all basic research work in aqueous based degreasing and lightweight protective ceramics and initiate transition of all programs to exploratory development. (905)
- Develop kinetic models for atmospheric fate of chloroflourocarbons (CFx) and other species for most promising HACs; perform quantum chemical simulations of infrared spectra for HAC decomposition products (for global warming predictions). (565)
- Down-select most promising DENOx additives; measure compatibility and aging characteristics of candidate propellant formulations. (566)
- Conduct laboratory validations of plant studies and evaluate aquatic microcosm systems. (834)
- Use the cytosensor to monitor status of soil microbial consortia. (204)
- Optimize biodegradative systems for mustard and sarin and evaluate biosurfactant/nutrient addition treatments for remediation of APG and SAEP soils. (998)

FY 1997 Planned Program:

- Synthesize cyclic nitramine using enzymatic methods. (1677)
- Complete all basic research work in aqueous processing and initiate technology transfer of all programs to CRDA partners. (976)
- Release final reports on halon alternative compounds research and transition to commercial sector for potential non-military applications. (609)
- Transition propellant additive results to exploratory development/advanced technology development gun propelling charge development program. (610)
- Complete validations and scaling comparisons and transition to site assessment and restoration programs. (899)
- Develop procedures for assessing toxic mechanisms (cellular and subcellular) of environmental pollutants. (220)
- Optimize biodegradative systems for DS2 and VX and demonstrate the removal of pollutants from water streams by means of enzymes, inorganic solvents and biomagnetic separation technology. (1076)

Project AH68 - Processes in Pollution Abatement Technology: This project provides fundamental understanding of the physical, chemical and biological properties and mechanisms that control the degradation and treatment of hazardous wastes on military installations. This research is used to obtain basic technical information necessary for the design of treatment systems for both cleanup of existing hazardous waste sites and control of future hazardous waste generation. Wastes of concern include explosives, propellants, chemical agents and smokes. This project supports exploratory development efforts in Program Element 0602720A, Projects AF25 and DO48.

FY 1994 Accomplishments:

- Conducted evaluation of trinitrotoluene (TNT) degradation methods; conducted evaluation of environmental factors affecting TNT degradation. (221)
- Determined specifications and operating protocols for bench scale photocatalytic treatment processes for reduction of aromatic compounds. (220)

FY 1995 Planned Program:

- Complete microbial degradation of explosives. (212)
- Set up laboratory and initiate experiments for RDX/HMX (explosives) biodegradation. (211)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (9)

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FY 1996 Planned Program:
- Initiate enzymatic studies of explosives degradation. (200)
- Identify bacterial cultures in RDX/HMX (explosives) biodegradation. (200)

FY 1997 Planned Program:
- Complete enzymatic studies of explosives degradation. (210)
- Isolate/identify microbial genera and define pathways in nitrocellulose (NC), nitroglycerine (NG), and dinitrotoluene (DNT) degradation. (210)

Project BS04 - Military Pollutants and Health Hazards: This element provides for the development of innovative, less costly, and less time consuming toxicity assessment methods for determining potential human health and environmental effects of military-unique hazardous wastes and chemicals, including explosives, propellants, and smokes. These new toxicity testing techniques will help to prioritize hazardous waste and waste treatment technologies and screen new Army chemicals for potential toxic effects.

FY 1994 Accomplishments:
- Identified candidate immunotoxicity test system and continuing. (99)
- Determined candidate microbial fate methods for inclusion in hazard estimation model and continuing. (303)
- Developed non-mammalian carcinogenicity bioassays and continuing. (374)

FY 1995 Planned Program:
- Develop neurotoxicity and reproductive toxicity models. (290)
- Develop chemical and multi-media environmental fate models. (320)
- Develop environmental risk prediction model. (112)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (16)

FY 1996 Planned Program:
- Develop immunotoxicity models. (300)
- Develop multi-media environmental fate models. (200)
- Develop risk prediction model. (185)

FY 1997 Planned Program:
- Identify risk assessment methods. (180)
- Identify methods and models for inclusion in an integrated multi-media environmental fate model. (90)
- Identify non-mammalian bioassay methods for use in a mobile biomonitoring facility and in laboratory assessments. (447)

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Project BS11 - Science Base/Medical Chemical Defense: This project emphasizes understanding of the basic mechanisms of action of nerve, blister, blood, and respiratory agents. Basic studies are performed to delineate mechanisms and site of action of identified and emerging chemical threats to generate required information for initial design and synthesis of medical countermeasures. In addition, these studies are further designed to maintain and extend a science base to prevent technologic surprises. Beginning in FY 96, funding for this project is transferred to DoD PE 0601384BP.

FY 1994 Accomplishments:
- Characterized cellular mechanisms and markers of sulfur mustard injury; developed new models of sulfur mustard injury (3673)
- Characterized mechanisms and markers of toxicity; developed new models of cyanide toxicity (958)
- Characterized cellular and brain mechanisms controlling nerve agent-induced seizures and pathology involving anticonvulsant and other therapy (812)
- Explored potential biological scavengers for chemical agents; applied biotechnological approaches to the development of scavengers (1964)
- Generated hypotheses and models to define mechanisms of action of Chemical Warfare (CW) threat agents (573)

FY 1995 Planned Program:
- Investigate medical countermeasures strategies based on cellular mechanisms and markers of injury and new models of sulfur mustard injury. (3029)
- Identify cellular and brain mechanisms controlling nerve agent-induced seizures and pathology involving anticonvulsant and other therapy. (1976)
- Explore potential biological scavengers for chemical agents; apply biotechnological approaches to the development of scavengers. (2152)
- Identify mechanisms of action of CW threat agents. (588)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (166)

FY 1996 Planned Program: Project moved to DoD PE 0601384BP project number D11.

FY 1997 Planned Program: Project moved to DoD PE 0601384BP project number D11.

Project BS12-Science Base/Medical Biological Defense: This project funds exploratory research on the development of vaccines and drugs to provide an effective medical defense against validated biological threat agents including bacteria, toxins, viruses and other agents of biological origin. By employing biotechnology, medical systems will be designed to rapidly identify, diagnose, prevent, and treat disease due to exposure to biological threat agents. Beginning in FY 96, funding for this project is transferred to DoD PE 0601384BP.

FY 1994 Accomplishments:
- Investigated the genetics and physiology of designated bacterial threat agents to understand how they cause disease. (3780)
- Conducted basic research on the genetic composition of designated viral threat agents. (1654)
- Conducted basic research on the physiological sites of action for biological toxins. (5612)
- Formulated intervention strategies for identified biological threat agents. (5650)

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FY 1995 Planned Program:

- Investigate the genetics and physiology of designated bacterial threat agents to understand how they cause disease. (3439)
- Determine the genetic composition of designated viral agents. (1535)
- Delineate the mechanisms by which drugs inhibit ricin cytotoxicity and determine the physiological sites of action for other biological toxins. (4940)
- Formulate intervention strategies for identified biological threat agents. (4660)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (313)

FY 1996 Planned Program: Project moved to DoD PE 0601384BP, project number D12.

FY 1997 Planned Program: Project moved to DoD PE 0601384BP project number D12.

Project BS13-Science Base Medical Research Infectious Disease: This project funds basic research on medical countermeasures for naturally occurring diseases which are militarily significant due to their potential impact on military operations. Development of medical countermeasures will protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations.

FY 1994 Accomplishments:

- Identified means of preparing sporozoite and blood stage malaria antigens as candidate vaccines; characterized blood and liver stage antigens and anti-idiotype monoclonal antibodies causing protective immunity as potential malaria vaccines. (1867)
- Re-emphasized drug discovery in the antimalarial core drug program through application of molecular modeling and computer assisted drug design; identified novel compounds effective against drug resistant malaria and leishmaniasis. (780)
- Acquired probes of known DNA sequence to use in rapid diagnosis of bacterial diarrhea, typhus, leishmaniasis, and malaria; determined global distribution of hemorrhagic fevers, hepatitis C and E, in military personnel. (2227)
- Identified virulence factors causing disabling diarrheal disease in military personnel; determined humoral and cellular immune responses necessary for protective immunity following vaccination against travelers diarrhea. (1353)
- Developed models to study genetically engineered vaccines against wound infections, hemorrhagic fever, meningitis, and dengue fever; identified new insect repellents against insect vectors of disease. (2311)

FY 1995 Planned Program

- Clone and sequence receptor in liver responsible for attachment and invasion by parasites as a possible target for malaria vaccines; determine etiology of emerging infections affecting deployed forces. Improve diagnostic tests for leishmaniasis. (2978)
- Determine basic mechanisms of host-parasite relationship of enterotoxigenic E. coli in cultured human colon cells; construct a genetically engineered Shigella strain in which virulence factors have been deleted as an oral vaccine against bacterial diarrhea. (1206)

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- Compare animal and human immune responses to dengue and hemorrhagic fever; test improved repellents against mosquitoes; apply CAD techniques to design antimalarial drugs capable of reversing resistance. (2842)
- Validate laboratory models for screening candidate vaccines against meningitis, gonorrhea, and wound infections; select DNA sequences for use in improved diagnostic tests for typhus fevers and campylobacter diarrhea. (1255)
- Grow hepatitis E in cell culture; assess the feasibility of a genetically engineered vaccine for European strain of hemorrhagic fever with renal syndrome. (1250)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (205)

FY 1996 Planned Program:

- Determine if there is natural immunity to re-infection by hepatitis E virus; identify technology to distinguish pathogenic strains of E. coli; identify means to prepare attenuated campylobacter strains as potential vaccine candidates. (1667)
- To support CAD of antimalarial drugs: identify key malaria parasite enzymes; clone and characterize key malaria enzyme; clone and characterize resistance genes. (1933)
- Assess clinical importance of emerging scrub typhus resistance to antibiotics. (1005)
- Identify key antigens of blood stage Plasmodium vivax capable of inducing protective immunity against relapsing malaria. (2055)
- Assess threats of high hazard viral diseases to global military operations. (2883)

FY 1997 Planned Program:

- Begin exploratory efforts for Norwalk virus gastroenteritis vaccine. (1322)
- To support structure based CAD of antimalarial drugs: express and crystallize malaria enzymes for determination of 3D molecular structure; express drug resistance genes, identify drug resistance mechanisms. (2071)
- Identify means to produce subunit (pilus, capsule or LPS conjugate) macromolecules as potential gonorrhea vaccines; identify monoclonal antibodies against wound infecting bacteria that protect animals from systemic septic shock. (1662)
- Begin exploratory efforts on a leishmania vaccine. (2342)
- Identify technology to improve site directed delivery of vaccine components; begin exploratory efforts directed at a West Nile fever vaccine. (2710)

Project BS14-Science Base/Combat Casualty Care: This project supports research to understand the basic mechanisms of combat related trauma. This research identifies trauma related topic areas, develops exploratory techniques, and initiates the experimental models necessary to support in-depth trauma research studies. This research is the basis for the development of trauma treatment and surgical procedures to extend "the golden hour" following trauma injury, minimize lost duty time from minor battle and non-battle injuries and combat stress, and provide military medical capabilities for far-forward medical/surgical care of battle and non-battle injuries.

FY 1994 Accomplishments:

- Identified importance of body fluid content, concentration, and composition in determining physiological responses to hemorrhage and shock; studied feasibility of innovative resuscitative therapies. (1450)

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- Evaluated various *in vivo* models for ability to serve as screening test-beds for the evaluation of efficacy of proposed therapeutic trauma treatments or drugs. (1605)
- Assessed the vascular responses to injury and resuscitation, and determined how massive tissue damage following trauma can be minimized. (228)
- Determined higher species responses to bovine osteogenin (bone growth compound) implanted in a tissue site. (110)
- Determined effects of cytokines (osteogenin and growth factors) on cultured bone cells. (500)
- Used CAD/CAM and robotics technology to design 3D/4D map capability for body surface. (330)

FY 1995 Planned Program:

- Refine mathematical modeling of the cardiovascular system to include both active and passive control elements (408)
- Determine the feasibility of antibody therapy to prevent further injury caused by massive blood loss and Acute Respiratory Distress Syndrome following trauma. (2039)
- Exploit new technologies (i.e., chemical fiber optic monitors, laser Doppler flow probes and tissue oximetry) to identify early tissue damage following injury. (169)
- Identify potential molecular mechanisms of neuronal injury due to reduced oxygen levels. (1448)
- Measure spinal cord blood flow after injury. (421)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (97)

FY 1996 Planned Program:

- Explore and exploit feasibility to treat septic shock with antibodies to lipopolysaccharide. (517)
- Identify feasible formulations for local hemostatic agents; fibrin glues, hematinics, chitin products, etc. (1493)
- Explore use of incomplete tourniquation, without causing limb anoxia, in extremity hemorrhage control. (336)
- Expand inventory of "smart fiber" sensor materials to offer greater choices for minimally invasive measurements. (995)
- Identify critical physiological markers following hemorrhage and trauma for non-invasive sensor development. (995)

FY 1997 Planned Program:

- Identify drugs or solutions which exceed the current "standard of care" in reducing brain swelling after trauma. (995)
- Exploit experimental model of multiple organ failure as test bed for identifying promising drug therapies. (1592)
- Determine effects of hibernation vs. hypothermia on cell metabolism; analyze risks vs. benefits. (796)
- Explore techniques for muscle cell salvage and repair for potential as therapeutic treatments for muscle trauma. (597)
- Identify factors important in re-animating subjects from suspended animation. (613)

Project BS15-Science Base/System Health Hazards Research: The scientific and technical objectives for this project focus on physiological and psychological factors limiting soldiers' effectiveness, and on the characterization of health hazards generated by military systems and resulting from military operations. Research is conducted on military relevant aspects of environmental physiology and the neurobehavioral aspects of stress. The hazards of exposure to several classes of non-ionizing radiation directed energy, blast, jolt, vibration, noise, and military relevant toxic chemicals are also investigated under this project. Specific tasks include delineating injury and effect thresholds, mechanisms, and sites of action. Emphasis is on protection, sustainment, and enhancement of the physiological and psychological capabilities of military

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personnel under combat operations in all environments. Research efforts are categorized by five major thrust areas: Operational Medicine and Performance; Environmental Extremes; Directed Energy Bioeffects; Toxic Hazards Health Effects; and Biodynamic Stresses.

FY 1994 Accomplishments:

- Characterized the metabolic changes in human brain during restorative sleep after sleep deprivation. (2125)
- Characterized the biological mechanisms of tolerance to environmental extremes. (2108)
- Evaluated the feasibility of using exogenously applied growth factors to stimulate retinal recovery after laser injury. (1570)
- Identified techniques to rapidly detect biological contaminants in field water. (1301)
- Defined hearing loss from exposure to freefield impulse blast from large caliber weapons. (1167)

FY 1995 Planned Program:

- Identify non-invasive biological markers of stress for determining effects of exposure to chronic stress. (1738)
- Identify nutritional and pharmacological strategies to reduce incidence and severity of heat-induced injuries. (1879)
- Characterize mechanism of injury from high-peak power, short-pulse duration microwave radiation. (1405)
- Assess the efficacy of techniques to rapidly monitor biological contaminants in field water. (1169)
- Identify the extent of iron deficiency in female soldiers. (1050)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (155)

FY 1996 Planned Program:

- Identify candidate compounds to enhance the restorative values of short duration sleep periods. (1641)
- Characterize gender related differences in susceptibility to heat-induced injuries. (1628)
- Characterize the time-course of ocular injury from ultra short-pulse laser pulses. (1216)
- Determine role of antioxidants in prevention of tissue damage from blast overpressure and toxic gas exposure. (1012)
- Identify the cellular consequences of hyperthermia useful for heat stress prevention. (906)

FY 1997 Planned Program:

- Identify strategies for preventing stress-induced suppression of immune function. (1736)
- Identify nutritional and pharmacological strategies to reduce incidence and severity of cold-induced injuries. (1726)
- Characterize the time course of injury from high-peak power, short-pulse duration microwave radiation. (1290)
- Characterize health effects of combustion products from advanced weapon firing. (1073)
- Investigate cochlear "toughening" as a potential means to reduce noise-induced hearing loss. (963)

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Project BS16-Science Base/Combat Dental Research: This project supports biomedical research directed toward understanding basic biological mechanisms underlying repair of militarily relevant maxillofacial injuries. This research is of fundamental importance to the development of treatments which enhance survival and sustain warfighting capability following battle and non-battle injuries.

FY 1994 Accomplishments:
- Explored new polymers for ability to biodegrade and release growth factors. (240)

FY 1995 Planned Program:
- Identify drug target tissue sites to treat immune failure in trauma patients. (114)
- Fabricate and test biodegradable bone screw. (81)
- Use bone repair material (BRM) to successfully stimulate growth of healthy, enduring bone in a critical bone defect. (135)
- Add video camera and laser optics to CAD/CAM project. (143)
- Evaluate effects of microencapsulated ampicillin on immunity. (59)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (12)

FY 1996 Planned Program:
- Continue identifying novel bioresorbable polymers to expand capability of treating "critical" (non-healing) bone defects. (102)
- Identify novel materials for use as long-lasting local anesthetic agents. (56)
- Identify or determine novel, more efficient technologies for lipid encapsulation of antibiotics and other drugs. (65)
- Identify lightweight, high tensile strength materials for supporting maxillofacial reconstruction. (102)
- Exploit software breakthroughs to develop algorithms necessary to accept, convert and interpret CAD/CAM data files. (171)

FY 1997 Planned Program:
- Investigate feasibility of methods for novel soft tissue reconstruction after combat trauma. (148)
- Examine feasibility of experimental methods for assessing tooth pulp blood flow far-forward after combat trauma. (148)
- Exploit recent advances in local hemostatic agents to control maxillofacial bleeding following combat injury. (120)
- Determine role for external orthopedic fixators to immobilize maxillofacial factures prior to surgical repair. (145)

Project BS17-Molecular Biology/Military HIV Research: This project provides for basic research for early diagnosis and identification of technologies to design prevention and treatment of HIV. The present emphasis is on identification and comparison of HIV strains from many geographical locations, characterization of etiologic agents and definition of tests for epidemiological surveys to design a vaccine to prevent disease. Current policy prohibits OCONUS assignments of antibody positive service members. A safe and effective vaccine for prevention of infection and intervention will permit all service members to become worldwide deployable.

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FY 1994 Accomplishments:
- Defined the immune response to unique HIV antigens after immunizations with subunit vaccines. (340)
- Defined the effect of virus variability on the selection of vaccine strains. (300)
- Described the effects of early infection on white blood cells in an animal model. (385)

FY 1995 Planned Program:
- Continue to evaluate effects of early infection on white blood cells in an animal model. (413)
- Study immune response, both humoral and cellular, after immunization with HIV antigens. (193)
- Evaluate variability in HIV genome. (135)
- Determine HIV infection prevalence and incidence. (193)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (20)

FY 1996 Planned Program:
- Maintain database/repository of global genetic/immunologic variants of HIV-1. (933)

FY 1997 Planned Program:
- Maintain database/repository of global genetic/immunologic variants of HIV-1. (959)

Project AT22 - Soil and Rock Mechanics: Basic research in this project develops the fundamental knowledge base required by the Army in the field of civil engineering. Current emphasis is on: determining and quantifying the non-linear, hysteretic response of deformable soils to transient loadings resulting from high-speed curvilinear vehicle maneuver; defining the constitutive behavior and penetration mechanics (including plastic deformation and microfracture mechanics) associated with projectile impact on complex geologic and structural materials; development of mathematical models needed for first principle analyses of explosive-induced ground shock and high-velocity projectile impact; development of analytic models and advanced construction materials for the design and construction of permanent or expedient operating surfaces both within CONUS and within a theater of operations; investigation of soil electromagnetic properties that affect in-situ obstacle discrimination and development of adaptive or responsive construction materials suitable for camouflage, concealment, and deception measures for fixed or semi-fixed assets. These technologies provide the basis for advanced research to provide: analytical capabilities for mobility assessments; hardened battlefield positions, fixed facilities, and semi-fixed assets; multispectral camouflage, concealment, and deception for fixed facilities; and advanced vertical and horizontal construction materials in PE 0602784A, Project AT40.

FY 1994 Accomplishments:
- Defined mechanical property variations/uncertainties for structure backfill and soil/rock materials; conducted high-pressure mechanical property tests on advanced high-ductility and high-density materials. (866)
- Developed algorithms to describe the response of soil subject to large discontinuous dynamic deformation using large-scale particle theory; conducted study using large-scale soil-particle model. (345)

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- Developed database and model of electromagnetic energy propagation through soils. (118)
- Performed signature characterization of material components of responsive (active) camouflage devices; synthesized experimental electroactive polymer films in the laboratory. (261)
- Developed steady-state dynamic pavement material model for airfield pavement design/evaluation application. (369)

FY 1995 Planned Program:

- Develop finite element code for dynamic structural analysis of deformable projectiles during penetration into geologic/concrete materials; conduct constitutive property analysis of high strength concretes for structural hardening. (913)
- Develop aggregate soil theory for evaluating soil subject to large-discontinuous soil deformations (dry and saturated soil conditions); compare aggregate soil theory with large-scale particle theory. (345)
- Verify electromagnetic propagation model via controlled field experiments. (120)
- Perform laboratory analysis of advanced responsive/passive composite materials for potential use in fixed-facility camouflage. (255)
- Develop and implement predictive model for response of granular pavement layers. (370)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (43)

FY 1996 Planned Program:

- Develop pavement fracture and durability mechanics models for application in predicting pavement performance. (350)
- Quantify performance parameters of advanced high-strength structural materials for anti-penetration shields/hardened structures. (975)
- Validate soil/climatological relationships for soil-moisture strength prediction in humid microthermal, undifferentiated highland, and humid mesothermal climates. (315)
- Provide quantitative recommendations for designing/selecting a sensor suite for in-situ discrimination applications. (100)
- Perform quantitative evaluations and matching of selected responsive/passive materials to backgrounds. (260)

FY 1997 Planned Program:

- Develop first-principle computer code to calculate long-rod penetrator performance during normal impact against concrete targets. (1017)
- Validate and document soil/climatological relationships for predicting/evaluating soil-moisture strength world wide. (364)
- Develop substrate specifications for materials to host respons.ve/passive Concealment and Camouflage deception (CCD) laminate materials. (280)
- Develop dynamic constitutive models for pavement materials and complete preliminary formulation of traffic distribution model. (457)

Project AT23 - Basic Research/Military Construction: This project supports development of fundamental knowledge essential to develop the leap ahead technologies required to solve Army and Defense (via Project Reliance) unique problems in the planning, programming, design, construction, and sustainment of force projection platforms and energy and utility infrastructure to achieve the ambitious infrastructure cost reduction goals of the current national military strategy. This project supports

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exploratory development efforts in Program Element 0602784A, Projects AT41 and AT45. This project also supports related Defense Modeling and Simulation Office-funded applications, and has significant dual use application potential.

FY 1994 Accomplishments:
- Defined method for object oriented, rule based system pattern matching essentia for next generation concurrent engineering applications. (1314)
- Completed alpha version of collaborative software development tools. (300)

FY 1995 Planned Program:
- Develop machine learning methods for a task modeling environment and for merging and versioning next generation concurrent engineering models. (1225)
- Construct models and concepts for integrating molecular "tags" into composite materials to enable creation of "smart building materials" that can be remotely queried to perform condition analyses. (509)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (38)

FY 1996 Planned Program:
- Incorporate abstract models that relate graphical display to mental models of users from different engineering disciplines. (525)
- Develop capability to integrate collaborative software systems. (325)
- Develop algorithms to predict post-elastic structural response of single degree of freedom systems under triaxial loading (935)

FY 1997 Planned Program:
- Develop models for self-responding self-repairing composites for infrastructure applications. (900)
- Develop models to predict the behavior of materials under load histories simulating earthquakes (938)

Project AT24 - Snow, Ice and Frozen Soil: This project is the only focused DoD basic research program investigating the physical, chemical and electrical properties of snow, ice and frozen soil and characterization of dominant winter and cold regions processes impacting military material, operations and facilities. It provides the knowledge base for exploratory development leading to reduced life-cycle costs and increased readiness and operability in extreme cold, high-altitude and seasonal winter conditions around the world. Products are directly input to PE 0602784A, Project AT42, as well as specific Navy and Air Force science and technology efforts, and forms the basis for much civilian applied research in these areas. It provides the fundamental knowledge base for developing concepts and approaches to upgrade materiel and doctrine for more effective performance in these challenging conditions.

FY 1994 Accomplishments:
- Developed model for millimeter wave (MMW) interaction with an evolving snow cover and experimentally verified relationship of turbulent fluxes with propagation statistics. (512)
- Integrated soil chemical processes into physical models of freezing-thawing and material behavior. (276)

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Related physical and electromagnetic properties of snow and ice for remote sensing and forecasting mechanical behavior, including acoustic sensing of snow permeability. (452)

FY 1995 Planned Program:
- Develop millimeter wave (MMW) scattering model for multiphase media. (470)
- Model unsteady freezing of soils under loads for infrastructure design. (247)
- Relate structural icing accumulation processes to winter storm characteristics and quantify vapor transport and solute release mechanisms in snow. (545)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (43)

FY 1996 Planned Program:
- Merge millimeter wave (MMW) scattering model for snow with infrared (IR) capability for dual-mode modeling for battlefield applications. (568)
- Model freezing effects on soil chemistry and behavior. (235)
- Define effects of electrical charging on snow friction and evaluate snow as a chemical absorption agent. (473)

FY 1997 Planned Program:
- Develop scattering model for ice. (584)
- Develop 2- and 3-D models for freezing of saturated soils. (226)
- Develop analysis of icing persistence; develop a model of ice inclusion size distribution over time. (542)

Project AT25 - Environmental Research - Corps of Engineers: This project provides the basic research needed to develop the technologies to address Army issues in the cleanup, compliance, conservation and pollution prevention areas. The focus in cleanup provides the basic knowledge needed to develop physical, chemical and biological technologies to clean up the Army's contaminated sites. In compliance and pollution prevention, efforts address knowledge gaps vital to maintaining compliance at non-industrial installations and fundamentals of training and test activity noise as they might be applied to reducing adverse effects on mission activities. The focus in conservation is on landform and ecological modeling and 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 exploratory development efforts in PE 062720A, Projects AF25, D048, and A896. 65% of the funds in this project are used to support extramural research via a Broad Area Announcement requesting proposed work supporting in-house laboratory efforts.

FY 1994 Accomplishments:
- Developed cryptogamic plant inoculation techniques. (400)
- Modeled the spatial relationships of ecological systems and landforms. (530)
- Verified mass balance and characterize glassy materials from laboratory tests of vitrification. (400)
- Developed fractal description of blast/wind noise signals. (276)

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- Defined hydroxyl radical formation mechanisms for chemical oxidation of explosives contaminated media. (800)
- Completed laboratory/field analysis of explosive residue and other contaminates transported near soil/snow interfaces. (400)

FY 1995 Planned Program:
- Design benchmark set of dynamic spatial applications for modeling complex environmental phenomena. (760)
- Field test propagation of cryptograms under field conditions. (858)
- Develop noise array design procedure. (760)
- Develop criteria and application control options for vitrification. (760)
- Complete environmental effects studies on degradation of TNT by Cyanobacteria Mats. (860)
- Analyze the dynamics of explosive residue and contaminate exchange at snow/air and water/ice interfaces. (660)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (100)

FY 1996 Planned Program:
- Develop species risk and richness models. (850)
- Establish optimum medium for biofilm propagation and perform sonochemical treatment of model compounds. (879)
- Verify groundwater modeling system scaling theory and evaluate and compare existing erosion models under instrumental field conditions. (950)
- Investigate solute exclusion and contaminate transport for frozen, snow-covered and ice-covered regimes and wetlands. (900)

FY 1997 Planned Program:
- Develop variance models for patterns of biodiversity and evaluate remote monitoring technologies for threatened and endangered species responses to Army training. (700)
- Develop erosion control techniques using cryptograms. (800)
- Identify fundamentals of spatial data visualization and registration. (800)
- Determine waste soil spectral signatures. (900)
- Evaluate soil, snow, ice, and contaminate parameters necessary to provide data fusion to describe transport processes in cold regions. (660)

Project A305 - Automatic Target Recognition (ATR) Research: This project focuses on the battlefield environment with its very challenging ground clutter problem, including areas not being addressed by the other Services, such as: automatic model-based generation of automatic target recognition (ATR) search trees; ATR physically implemented on the focal plane array; model-based automatic recognition of one dimensional infrared signals (chemical detection); information-based theories applied to target signature analysis; and low depression angle, short range scene modeling for target acquisition and endgame.

FY 1994 Accomplishments:
- Verified/validated a 3-dimensional multi-spectral scene generation model with field collected data (infrared). (862)

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- Developed focal system simulator, and developed algorithms to enable development of smart focal plane arrays. (803)

FY 1995 Planned Program:

- Investigate image compression of SAR and FLIR images using wavelet vectoquantization. (100)
- Perform synthetic aperture radar (SAR) image model evaluation. (306)
- Increase the efficiency of high quality scene modeling towards real time scene simulation. (474)
- Develop an algorithm capable of generating a multisensor ATR algorithm with near optimal performance from mathematical imagery model input. (703)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (34)

FY 1996 Planned Program:

- Extend recent advances made in speech and handwriting recognition to develop a hierarchical hybrid neural model-based ATR algorithm structure for the 2-D ATR problem. (508)
- Investigate recent advances in the sciences of combinatoral optimization & computational geometry to approach near optimal search solutions for ATR algorithms.(345)
- Develop modeling techniques which allow the extension of multi-spectral scene generation (MSSG) to synthetic environment applications. (220)

FY 1997 Planned Program:

- Develop hierarchical syntax/grammar for hybrid neural model based ATR algorithms to include higher level model structures. (507)
- Apply learning theory to the ATR problem in order to automate the feature selection process. (409)
- Develop techniques for extension of MSSG to real-time virtual reality environment. (253)

Project A31B - Infrared Optics Research: This project sustains the Army's theoretical and experimental research in night vision and electro-optic technology. It generates new technologies so we can continue to "own the night," notwithstanding increased foreign competition. The research is focused upon new dual-use materials, devices and techniques relative to infrared focal plane arrays (IRFPAs), directed energy sources and protection against directed energy sources. Emphasis is placed on the development of technology for high performance smart IRFPAs and on uncooled low-cost medium performance IRFPAs based on thin film ferroelectric materials. Applications for uncooled IRFPAs include improved night navigation and surveillance for both military and civilian usage. In the directed energy arena, efforts are focused on wide bandgap laser diode arrays that emit in the blue, blue-green wavelength regions, new tunable laser sources in the visible wavelengths and development of frequency diversity techniques to obtain directed energy in the 3-5 micron region. Main Army applications are for countermeasures and remote chemical detection. There are many important civilian applications, such as: optical recording/storage, optical image processing, optical computing, display devices, and medical non-invasive imaging. 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 storage.

FY 1994 Accomplishments:

- Grew full monolithic detector substrate structure for smart IRFPA: silicon/gallium arsenide/cadmium zinc telluride (Si/GaAs/CdZnTe). (591)

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- Developed improved ferroelectric thin films for uncooled IRFPAs. (602)
- Demonstrated visible laser material for pumping by ultra violet (UV)/visible diodes. (1461)

FY 1995 Planned Program:
- Optimize Si/GaAs/CdZnTe structures for mercury cadmium telluride (HgCdTe) detector growth. (775)
- Demonstrate efficient, directed energy conversion through optical parametric amplifier in the 3-5 micron region. (541)
- Process laser diode array on Si/GaAs substrate for chip to chip communication. (530)
- Demonstrate uncooled IRPFA based on thin film ferroelectrics. (580)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (52)

FY 1996 Planned Program:
- Fabricate blue/green laser diodes for compact, efficient, visible laser sources and demonstrate room temperature operation for high efficiency pumping of visible laser sources for optical countermeasures and non-lethal weapons. (1070)
- Deliver an optimized, efficient 3-5 mm optical parametric oscillator (OPO) to provide tunable laser output in the required wavelength bands for IR countermeasures (IRCM) to Night Vision Electronics Sensors Directorate (NVESD). (1071)

FY 1997 Planned Program:
- Fabricate, demonstrate blue/green laser diode array with greater power than a single diode and which will be a compact efficient laser source alone, or capable of pumping visible emitting laser materials for greater efficiency devices for optical countermeasures and non-lethal weapons. (1208)
- Demonstrate and deliver to NVESD an optimized visible emitting laser material that can be pumped with blue/green laser diode arrays for a compact, efficient, higher power laser source that emits in the visible. These components will be integrated into the advanced lightweight countermeasure system (LCMS) for the Infantry School and for biological agent detection systems. (1080)

Project B52C - Mapping and Remote Sensing: This project supports research in fundamental topographic sciences to improve the tactical commander's knowledge of the battlefield; to extract natural and man-made features from reconnaissance imagery in near-real time; to exploit terrain reasoning/artificial intelligence techniques for distributive interactive simulation (DIS) and for combat planning and operations; to support unmanned/autonomous vehicle navigation using sensor enhanced dynamic data bases; and to explore the potential of space technology to provide real-time terrain intelligence, command and control, and targeting support. The research provides the theoretical underpinnings for Program Element 0602784A, Project A855.

FY 1994 Accomplishments:
- Obtained fine-resolution terrain elevation data on military reservations using interferometric synthetic aperture radar with other sensor data for hasty mapping; investigated generation/exploitation of high-resolution digital elevation data for small-unit simulation/modeling. (1075)

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- Defined neuro-computing routines employing spectral and spatial information for classifying hyperspectral imagery and use wavelet transforms for image compression. (727)
- Investigated the application of spectral reflectance and thermal data to monitor environmental processes and to estimate plant productivity in support of the narcotics program. (685)

FY 1995 Planned Program:
- Investigate the application of multi-sensor imagery data for support of simulation and modeling. (1000)
- Develop neural net/computer algorithms for enhancing image classification accuracy and feature extraction capability from interferometric synthetic aperture radar imagery and integrate with wavelet techniques for image segmentation. (643)
- Instrument desert test site for collecting data on change detection using hyperspectral imagery; develop algorithms for enhancing multi/hyperspectral imagery classification and feature extraction. (900)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (55)

FY 1996 Planned Program:
- Research techniques to automatically upgrade the accuracy and density of standard (Defense Mapping Agency and U.S. Geological Survey) digital elevation data and design an open architecture system for processing spectral data to support terrain visualization and environmental monitoring. (1004)
- Assess complex neural net architectures for feature extraction and image classification and perform 3-D image compression with wavelet transforms. (570)
- Investigate the application of multiple sensors for detecting and monitoring environmental issues; integrate hyperspectral data and imagery with geographic information systems. (965)

FY 1997 Planned Program:
- Study automated knowledge based feature extraction modules to simplify applications in basic topographic sciences. (1013)
- Validate concept for a wavelet transform/neural network-based image data classification system operating on interferometric synthetic aperture radar data. (615)
- Research algorithms for enhanced data classification and feature extraction from next generation multi-sensor imagery. (1062)

Project B53A - Battlefield Environment and Signatures: Provides in-depth understanding of the complex atmospheric behavior associated with electro-magnetic propagation, transport and diffusion, and remote sensing, which affect Army operations and systems such as electro-optics, smoke deployment and target designators. Supports Project Reliance sub-areas of lower atmospheric sciences and terrestrial sciences with a lead role in boundary layer processes and interactions over terrain.

FY 1994 Accomplishments:
- Developed advanced concepts and models for improved Transport & Diffusion dynamics (comple.. terrain & structures) and incorporated photorefractive crystal technology into simulation of optical turbulence effects on imaging (682)
- Developed spectral and polarimetric propagation models for realistic computer simulation of the atmosphere; compared model output with ground truth data. (901)

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- Determined impact of atmospheric turbulence-induced "shimmer" on imaging system performance and simulated at video rates using hybrid optical/digital processing techniques. (1517)
- Developed methods to determine the internal structure of layered and inhomogeneous particles for bio-chemical agent applications. (909)
- Developed radiative effects model for battlefield obscurants; and developed color contrast transmission model applicable to realistic battlefield visualization. (1065)
- Developed urban wind flow model (395)

FY 1995 Planned Program:

- Develop high-fidelity atmospheric transport and diffusion model for calculating wind flow and nuclear, biological, chemical (NBC) agent concentration evolution through urban areas. (1079)
- Determine and describe the processes that cause the formation and dissipation of boundary layer gravity waves, and define coupling of boundary layer meteorology, radiative, and diffusion models (1360)
- Develop a prototype counter for detection of single airborne biological particles using laser-induced autofluorescence (633)
- Develop high-fidelity visualization/simulation capability by inclusion of polarization effects in the battlefield emission and multiple scattering (BEAMS) model. (814)
- Develop and evaluate the Weather and Atmospheric Visualization for Environments Simulations (WAVES) suite of models that calculates and visualizes environmental effects due to natural clouds, haze, and fog (814)
- Develop 3-dimensional stratified-atmosphere, acoustic propagation theory to account for earth curvature at extended ranges. (591)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (113)

FY 1996 Planned Program:

- Develop adaptive optical system for mitigation of severe atmospheric-induced phase distortions affecting optical systems. (1255)
- Develop analytical solutions to the nonlinear stochastic Navier-Stokes equations to provide ultra-fast meteorological and turbulence predictions over complex terrain and structures of military significance on the digitized battlefield (898)
- Develop a model for boundary layer coherent structures over vegetation. (660)
- Investigate the utility of fluorescence excitation and emission spectra for differentiating between biological and non-biological aerosol. (760)
- Incorporate wind effects and turbulence into 3-dimensional acoustic propagation model. (786)
- Develop the methodology for mitigation of atmospheric effects in visible color imagery. (962)

FY 1997 Planned Program:

- Apply neural network processing techniques to optical processing scheme for adaptive self-learning mitigation of atmospheric-induced phase distortions. (848)
- Develop analytical solutions to the coupled nonlinear atmospheric diffusion-advection equations, Navier-Stokes and propagation equations to provide ultra-fast solutions for obscuration, chemical and biological hazard prediction on the digitized battlefield. (700)
- Define and characterize the diurnal behavior of the atmospheric boundary layer over a desert. (946)
- Determine polarized light angular scattering properties of inhomogeneous particles characteristic of encapsulated biological agents. (1265)

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- Complete prototype 3-dimensional acoustic propagation model for inclusion into acoustic decision aid. (822)
- Develop experimental techniques for using stereoscopic effects on atmospheric imaging. (1053)

Project A71A - Research in Chemical Warfare/Biological Warfare Defense: The purpose of this project is to obtain. through basic research in chemistry, physics and life sciences, fundamental information in support of: new and improved defensive systems for biological agents and toxins; new and improved defensive systems for chemical threat agents; new concepts in decontamination, aerosol and obscuration studies for the Army smoke program; determinations of the environmental fate and impact of militarily unique processes. Beginning in FY 96, funding for this project is transferred to DoD PE 601384BP.

FY 1994 Accomplishments:

- Designed and tested DNA probes and primers for the identification of pathogenic Clostridia, Clostridium perfringins, and Clostridium perfringins toxin producers and demonstrated microbial degradation of hydrolyzed munitions-grade mustard. (640)
- Devised a method to identify bacterial genes and their regulators that are inactive outside the body but active once inside a host. (148)
- Demonstrated optical detection scheme for several different bacteria using antibodies, fluorescence, and light scattering. (900)
- Developed procedure for the hydrogenolysis of hindered tertiary alcohols as a synthesis pathway to target alpha 2-adrenergic sedatives with potential as non-lethal chemicals. (403)
- Developed approach to perform precise mass determination of trapped micron-sized particles by optical means. (540)
- Measured absorption equilibria of CW agent simulants on developmental adsorbent materials for protective masks. (399)
- Analyzed the effect of phase transfer catalyst in both the oxidation and the hydrolysis reactions of sulfur mustard and determined synthetic parameters for controlled large scale synthesis of starburst polymers. (630)
- Modeled fluorescence of solvated aromatic amino acids in biological systems. (432)

FY 1995 Planned Program:

- Transition Clostridial and Yersinia probes to exploratory development and begin work on DNA primer and probe development for additional organisms of interest to the U.S. Army. (750)
- Demonstrate optical recognition of microencapsulated aerosol particles (detection of layers) by light scattering from single aerosol particles. (798)
- Model the performance of new air filtration techniques using combined separation systems. (405)
- Complete and evaluate effort in laser mass spectrometric analysis of suspended single bacterial particles. (453)
- Complete initial toxicological studies on series of ultra-quick acting synthetic opioids using a sensory evoked potential (SEP) technique as an indicator of safety and effectiveness of candidate non-lethal chemicals. (345)
- Determine the reaction mechanism of mustard-hydroperoxide reaction and explore hybrid Starburst polymers as substrates for biodetection devices. (200)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (63)

FY 1996 Planned Program: Project funded in PE 601384BP.

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FY 1997 Planned Program: Project funded in PE 601384BP.

Project B74A - Human Engineering: This project supports research on soldier performance, including the areas of visual, auditory, cognitive, and stress-related performance. The objective is to identify, describe and manage underlying human-system interface factors critical to the design of Army weapon systems. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP), the Science and Technology Objectives (STOs), and the Army Modernization Plan. All work under this PE is part of the "Human-Systems Interfaces" Tri-Service Reliance Panel.

FY 1994 Accomplishments:

- Conducted research on cognitive-behavioral performance related to graphical information display. (360)
- Completed high fidelity studies on perceived target position in the field using 2D display, and effects of training on perception of 3D information on 2-D display. (433)
- Completed studies comparing combat identification (ID), ranging performance with and without programmed combat ID devices. (461)
- Initiated study of effects of field-of-view and resolution on remote vs. onboard driving performance. (777)
- Reactivated NATO Research Study Group; considered ear model for international use. (335)
- Demonstrated validation of salivary amylase procedures as a stress measurement tool for field use. (237)

FY 1995 Planned Program:

- Expand graphical information display research by developing and testing decision aids for ground-combat personnel. (443)
- Study to isolate human errors due to deficiencies of visual cues caused by limited depth perception with night vision devices. (949)
- Establish field-of-view and resolution requirements for remote driving. (293)
- Propose international noise standard; demonstrate "meter" for assessing noise hazards. (467)
- Develop stress amylase procedures for field use. (304)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (53)

FY 1996 Planned Program:

- Design, construct and characterize optical processors for image and signal processing, incorporating refractive, diffractive and/or integrated optical elements. (314)
- Continue research on components for optical control of microwaves by combining integrated optic beam splitter with phase modulators and amplifier structures. (286)
- Construct and characterize photonic implementations of cyclic correlation algorithms. (434)
- Demonstrate hybrid integrated smart pixel employing vertical cavity surface emitting lasers for 2D optical processing, image processing, and neural nets for aided target recognition. (721)
- Investigate ferroelectric/field effect transistor (FE/FET) approaches to developing simple memory cell designs for very high density non-volatile memories. (196)
- Apply the giant magnetoresistive (GMR) effect to non-volatile memory design. (403)

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FY 1997 Planned Program:

- Incorporate on-chip processing and optical pre-processing on two dimensional photodetector arrays for improved performance and functionality. (355)
- Design photonic based integrated optic processor for optical control of microwaves and phased arrays. (302)
- Research photonic implementations of automatic target recognition (ATR) and other signal processing algorithms. (143)
- Demonstrate high density hybrid smart pixel array employing vertical cavity surface emitting lasers for 2D optical processing, image processing, and neural nets for aided target recognition. (785)
- Demonstrate radiation survivable FE device for high density non destructive read out (NDRO). (202)
- Investigate radiation effects in silicon/germanium (Si/Ge) and gallium nitride (GaN) devices. (409)
- Investigate effects of radiation on monolithic silicon carbide (SiC) circuits and nonvolatile memory. (403)

Project B74F - Personnel Performance and Training: This project conducts behavioral science research in the following areas of human performance: variables and processes determining effective group functioning, leader-group interaction, and decision-making; and principles of technology-based instructional methods that promote the learning of cognitive, perceptual-motor, and unit performance tasks by individuals and groups.

FY 1994 Accomplishments:

- Completed assessment of and initiated new research on peace operations problems and comparative personnel policies. (429)
- Published leader-experience research and continued efforts to clarify role of motivation in sharpening leader skills. (796)
- Supported Army readiness efforts with continuation of research on long-term skill retention and transfer. (1202)
- Explored advanced techniques to facilitate battlefield alertness at night and developed understanding of role of personality in performance. (601)

FY 1995 Planned Program:

- Continue chronopsychological research contributing to *owning the night*, and explorations of new methodologies for behavioral research & performance analysis. (420)
- Extend research on sociological conceptions of functional Army elements, peace operations, and attitudes underlying career choice and enlistment propensity. (710)
- Continue analysis of leader behavior as influenced by motivational variables, and explore measures of leadership. (1050)
- Initiate research to facilitate "on demand" and "just in time" training for teams and individuals. (632)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (60)

FY 1996 Planned Program:

- Initiate research on soldier skills for flexible operations and continue Army social structure analyses. (516)
- Complete research on the sharpening of leader skills and the impact of leadership on organizational dynamics and productivity. (633)
- Continue research on new issues in training and determine behavioral mechanisms that underlie the relationship between performance in simulators and the real world. (926)
- Fine-tune methodology for extended multivariate research in behavioral science, and explore behavioral techniques to facilitate fast learning. (703)

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BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Sciences

FY 1997 Planned Program:

- Continue research on soldier skills for flexible operations, attitudes underlying career choice, and societal issues affecting Army personnel policies. (1035)
- Initiate research on generating elite performance, and continue efforts on transferring virtual training to real environments. (1100)
- Explore the potential of facet analysis and innovative multivariate methods in behavioral research. (416)
- Develop methods for increasing soldier motivation and soldier effectiveness. (401)

Project B782-Biotechnology Information Facilities: This is a Congressionally directed project to fund a competitively-awarded grant for computing, data, and communications networks and associated facilities in support of engineering biotechnology facilities.

FY 1994 Accomplishments: Project not funded in FY 1994.

FY 1995 Planned Program:

- Fund a competitively awarded grant for biotechnology facilities (9658)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (207)

FY 1996 Planned Program: Project not funded in FY 1996.

FY 1997 Planned Program: Project not funded in FY 1997.

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	190600	195346	198241	198915
Appropriated Value	190600	201706		
Adjustments to Appropriated Value (Total PE)	-5215			
a. SBIR/STTR decrement (-2840)				
b. Reprogrammed out of PE (-2375)				
Current President's Budget Submit	185385	201706	127565	135285

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DATE: February 1995

BUDGET ACTIVITY: 1 - Basic Research

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

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	5618	8617	62715	61855	66933	69338	74792	80196	Continuing	Continuing
BH50 Telecommunications Research	0	0	10150	10050	11060	11345	12690	13967	Continuing	Continuing
BH53 Advanced Distributed Interactive Simulation Research	0	0	6965	6965	7744	7961	8993	9977	Continuing	Continuing
BH54 Advanced Sensors Research	0	0	9971	10049	11120	11585	12869	14163	Continuing	Continuing
BH55 Software and Intelligent Systems Research	0	0	5324	4876	5419	5573	6295	6983	Continuing	Continuing
BH56 Advanced Displays Research	0	0	5373	4876	5419	5573	6295	6983	Continuing	Continuing
BH59 University Centers of Excellence	0	0	5970	5970	5970	5971	5996	5986	Continuing	Continuing
BH62 Electromechanics and Hypervelocity Physics	5618	8617	10007	10024	11064	12096	12285	12681	Continuing	Continuing
BH64 Materials Center of Excellence	0	0	2985	2985	2985	2986	2997	2993	Continuing	Continuing
BH65 Microelectronics Center of Excellence	0	0	2985	2985	2985	2986	2997	2993	Continuing	Continuing
BH73 National Automotive Center of Excellence	0	0	2985	3075	3167	3262	3375	3470	Continuing	Continuing

A. Mission Description and Budget Item: The Army's initiative to create an open, federated laboratory system is an innovative and forward thinking approach focusing the talents of industry and academia on critical technology needs of the Army. The federated laboratory is a partnership between ARL and the private sector involving cooperative agreements, integrated management and staff rotation, education and communication. The basic construct of a federated laboratory is to continue strong in-house involvement to meet Army-unique requirements where there is little external expertise in the technologies; but to forge direct associations with industry/university consortia with recognized competencies in specific technology areas where the centers of expertise are definitely outside of the Government (i.e. telecommunications). Under federated laboratory, ARL will form partnerships with consortia consisting of at least one each of an industrial company, a major university, and a Historically Black College or University/Minority Institution (HBCU/MI). Long-term cooperative agreements (5-8 years) will be established in 5 key areas, and these consortia will become "virtual labs" within ARL and function like any other ARL division. Work will be jointly planned and executed and Army scientists and engineers will be intermingled through long term assignments with the consortia. The federated laboratory approach for ARL is in accordance with 1991 Base Realignment and Closure, and the Department of Defense mandate to exploit private sector research and reduce infrastructure. This program element also includes the Army's Centers of Excellence, which

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are the centerpiece of academic linkage to Army R&D organizations. Centers of Excellence continue to be an integral part of the Army's research investment strategy, along with single investigator programs and Army laboratory research. Centers have proven to be highly effective in many applications-oriented projects, in areas such as rotary wing technology and electronics. Centers couple the state-of-the-art research programs with broad-based graduate education programs to increase the supply of scientists and engineers in areas of Army importance. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and DoD Project Reliance. The projects in this PE include basic research efforts directed toward providing fundamental knowledge for the solution of military problems and therefore are correctly placed in Budget Activity 1.

Project BH50 - Telecommunications Research: This project establishes long term collaboration between ARL and competitively selected industry/university consortia for the purpose of leveraging world class research relevant to Army needs. Battlefield telecommunications involve the reliable, timely, and secure electronic transport of multi-media information over heterogeneous, digital networks exhibiting dynamic topologies. The technical areas that will be addressed under this project are: Wireless Battlefield Digital Communications; Tactical/Strategic Interoperability; Information Distribution; Multi-media Concepts; Additional Research.

FY 1994 Accomplishments: Project not funded in FY 1994.

FY 1995 Planned Program:

- A Broad Agency Announcement (BAA) was issued in December 1994 to solicit proposals for this Center. Award will be 1QFY96 or earlier, if possible.

FY 1996 Planned Program:

- Research in wireless battlefield digital communications, tactical/strategic interoperability, information distribution and multimedia concepts will be initiated by the Army/industry/university team. (10150)

FY 1997 Planned Program:

- Continue research in wireless battlefield digital communications, tactical/strategic interoperability, information distribution and multimedia concepts. (10050)

Project BH53 - Advanced Distributed Interactive Simulation Research: This project establishes long term collaboration between ARL and competitively selected industry/university consortia for the purpose of leveraging world class research to develop modeling and simulation technologies that enable real-time and efficient information transfer and management throughout the hierarchical structure of a battlefield force. Emphasis is on research to support the establishment of a seamless, user-friendly synthetic environment for networked battlefield command, control, communications, and computing where all operational functionalities can concurrently be carried out assisted by intelligent systems. This includes algorithms and methodologies for automation aided situation-adaptive planning, rehearsal, and execution with real-time command and control, using electronic maps, resource availability data, intelligence information, and operational procedures.

FY 1994 Accomplishments: Project not funded in FY 1994

FY 1995 Planned Program:

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- A Broad Agency Announcement (BAA) was issued in December 1994 to solicit proposals for this Center. Award will be 1QFY96 or earlier, if possible.

FY 1996 Planned Program:
- Research in synthetic environments for digitization, automation-aided operations, and physical environment representation will be initiated by the Army/industry/university team. (6965)

FY 1997 Planned Program:
- Continue research in synthetic environments for digitization, automation-aided operations, and physical environment representation. (6965)

Project BH54 - Advanced Sensors Research: This project establishes long term collaboration between ARL and a competitively selected industry/university consortia for the purpose of leveraging world class research relevant to Army needs. Advanced Sensors are the elements of systems that view the environment and convert the basic raw sensor data into meaningful information suitable for transmission over tactical networks. The technical areas that will be addressed under this project are: Multidomain Smart Sensors to include multispectral infrared focal plane arrays; Multisensor Fusion Automatic Target Recognition Algorithms to include synthesis of sensor modeling; Radar Sensors to include atmospheric and terrain effects on propagation; and Signal Processing capitalizing on commercially available hardware.

FY 1994 Accomplishments: Project not funded in FY 1994

FY 1995 Planned Program:
- A Broad Agency Announcement (BAA) was issued in December 1994 to solicit proposals for this Center. Award will be 1QFY96 or earlier, if possible.

FY 1996 Planned Program:
- Research in multidomain smart sensors, multisensor fusion automatic target recognition algorithms, radar sensors, and signal processing will be initiated by the Army/industry/university team. (9971)

FY 1997 Planned Program:
- Continue research in multidomain smart sensors, multisensor fusion automatic target recognition algorithms, radar sensors, and signal processing. (10049)

Project BH55 - Software and Intelligent Systems Research: This project establishes long term collaboration between ARL and competitively selected industry/university consortia for the purpose of leveraging world class research relevant to Army needs. Intelligent Systems are machines and software that can process artificially sensed information, using well defined objectives, to make appropriate decisions. Those decisions are then translated into actions. The technical areas that will be addressed under this project are: Language Translation and Understanding to include the semantics and pragmatics of natural language and development of a lexicon to support robust translation; Intelligent Agents to include image understanding and automated learning.
FY 1994 Accomplishments: Project not funded in FY 1994.

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FY 1995 Planned Program:

- A Broad Agency Announcement (BAA) was issued in December 1994 to solicit proposals for this Center. Award will be 1QFY96 or earlier, if possible.

FY 1996 Planned Program:

- Research in language translation and understanding, and intelligent agents will be initiated by the Army/industry/university team . (5324)

FY 1997 Planned Program:

- Continue research in language translation and understanding, and intelligent agents. (4876)

Project BH56 - Advanced Displays Research:. This effort establishes a competitively selected university/industry consortia to provide solutions for the many requirements for information assimilation on the battlefield. Displays and Control constructs are the interface between human users and computers. This center will develop display subsystem architecture which can provide access to all information of practical use, provide data visualization in an efficient manner and use the advanced hardware and software technologies to address the human sensory modality without overloading the user and degrading performance. Work in this project differs with ARPA's program which aims to establish a domestic capability for display development. The technical areas being addressed under this project are: Human-Computer Interface in an Information Rich Environment; Display Configuration, real time visualization, architecture, information presentation, and control coupling.

FY 1994 Accomplishments: Project not funded in FY 1994.

FY 1995 Planned Program:

- A Broad Agency Announcement (BAA) was issued in December 1994 to solicit proposa's for this center. Award will be 1QFY96 or earlier, if possible.

FY 1996 Planned Program:

- Research in human-computer interface in an information rich environment, and display configuration will be initiated by the Army/industry/university team. (5373)

FY 1997 Planned Program:

- Continue research in human-computer interface in an information rich environment, and display configuration. (4876)

Project BH59 - Centers of Excellence: Work in this project was previously conducted in PE 0601102A, project BH57. Army Centers of Excellence are active in the fields of artificial intelligence, rotary-wing technology, the mathematical sciences, fuel cell technology, the foundations of image science, and training. The Army's Centers have significant collaborative participation by Historically Black Colleges and Universities/Minority Institutions (HBCU/MIs) and all future Army Centers will be formed in partnership with an HBCU. In addition, industry will be encouraged to "buy into" future Army Centers of Excellence to leverage and synergize the investment in these collaborative efforts.

FY 1994 Accomplishments: Work conducted in PE 0601102A, Project BH57

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FY 1995 Planned Program: Work conducted in PE 0601102A, Project BH57

FY 1996 Planned Program:

- Rotorcraft Center of Excellence - Conduct interdisciplinary investigations on topics of specific relevance to the Army's rotorcraft science and technology base including aerodynamics, rotor vibration, and damage characterization at Rensselaer Polytechnic Institute, University of Maryland, and Georgia Institute of Technology (2500)
- Conclude the research in the Mathematical Sciences Institute focusing on computational algebra, stochastic analysis and nonlinear wave high resolution simulation (720)
- Investigate the fundamental issues of image science that limit target acquisition by developing algorithms, architectures, formats and techniques for clutter classification (2000)
- Advance training technology at Morris Brown College through research in computer simulation training of cooperation and team performance, and critical decision making (750)

FY 1997 Planned Program:

- Conduct interdisciplinary investigations on topics of specific relevance to the Army's rotorcraft science and technology base including aerodynamics, rotor vibration, and damage characterization (2500)
- Advance fuel cell and battery techniques at the Illinois Institute of Technology with emphasis on lithium-ion/metal oxide and nickel/hydride batteries and direct oxidation methanol fuel cells (720)
- Advance interdisciplinary research related to the foundations in image science by developing algorithms, architectures, formats and techniques for clutter classification (2000)
- Advance training technology at Morris Brown College through research in the relationships between instruction and memory strategy, and auditory enhancement of computer interfaces (750)

Project BH62 - Electromechanics and Hypervelocity Physics: Tactical demands on the future battlefield will require more mobile and lethal weapons systems having greater range and lethality, and reduced logistical demands to speed deployability and support. Combat vehicles, weapons and other tactical systems must utilize technologies beyond the current state-of-the-art in propellants, materials and electromechanical devices to achieve major technical and operational breakthroughs for future generations of military systems. This project funds the Army Federated Laboratory at the Institute for Advanced Technology (IAT). Electromechanics and hypervelocity physics support critical Army research relating to electromechanical systems for application to electromagnetic (EM) and electrothermal-chemical (ET-C) guns. Additionally, this project provides for research, testing and computer modeling of advanced hypervelocity (HY) projectiles. These focused efforts serve as catalysts for technological innovation and provide crucial support to the Army technology base for advanced weapons systems development with potential applications for anti-armor, artillery and air defense.

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FY 1994 Accomplishments:

- Designed, fabricated and tested advanced armatures and materials for damage resistant surface engineering of rail conductors; conducted armature/rail pair optimization experiments to maximize electrical to kinetic energy conversion; completed testing of a 25mm x 3m distributed energy system (DES) test bed to validate DES concept and evaluate advanced armatures and materials (2640)
- Continued experimental program to expand the hypervelocity data base for scaled 1/d+30, long rod penetrators vs. technology targets; examined the penetration effectiveness of various scaled novel penetrators; conducted research to verify new cavity expansion models for penetration of ceramics and metals; began characterization of behind armor debris as a function of velocity for hardened alloy like targets (2529)
- Developed Hypervelocity and Electric Armaments Phase II course; expanded library to serve as electric armaments technical information center; completed the second Senior Service College Fellowship Program and the first Executive MBA program: continued the High School Apprenticeship and U.S. Military Academy Cadet Summer Programs; and developed a pilot program for outreach to high school science classes by scientists and researchers at IAT (449)

FY 1995 Planned Program:

- Conduct: limited breadboard testing of integrated energy storage and transfer (IEST) concept; limited testing of materials for advanced armatures, rails, and solid state for IEST; post-test analyses of bores of all 90 mm EM guns operated at multi-megajoule energy levels; and experiments to improve DES efficiency through use of energy injections at larger number of launcher feedpoints (2328)
- Conduct experiments to examine mechanics of oblique plates and reactive targets as a function of velocity; continue research and development of most promising novel penetrators for enhanced penetration; develop data to support improved dynamic constitutive models for hardened alloys and ceramics (2179)
- Conduct two technical workshops in Hypervelocity Physics/Electromechanics (HV/EM) for Army electric armaments engineers; upgrade and expand the technical information center to increase electronic accessibility; facilitate development and coordination of graduate degree programs in related areas for Army Acquisition Corps; and continue the intern apprenticeship and summer programs associated with HV/EM (413)
- Conduct research in pulse power (3567)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (130)

FY 1996 Planned Program:

- Conduct continued breadboard testing of IEST concept; conduct enhanced materials for armatures, rails, and solid state IEST; conduct exploratory research on selected designs for optimum DES efficiency (4738)
- Conduct continued mass-velocity tradeoffs and study of advanced penetrators against reactive targets; conduct detailed testing of most promising novel penetrators; provide continued development of dynamic constitutive models for Rolled Homogenous Armor, Tungsten Heavy Alloy, and ceramics; validate behind armor debris and lethality models; analyze dispersion control and active stabilization of launch packages (4241)
- Develop and conduct technical courses in Basic E-Gun Theory Phase II and Launcher Systems; conduct workshops in Total Quality Management requirements related to unique engineering manufacturing processes for E-Gun; continue support for the technical information center; and conduct apprenticeship and summer programs associated with HV/EM (1028)

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FY 1997 Planned Program:

- Characterize and develop most promising IEST concept; continue detailed materials testing for electric armaments components; and determine DES concept for development (4694)
- Select and characterize best novel penetrator for development; confirm penetrator design through the use of lethality models (4280)
- Develop and conduct tutorial courses in aeroballistic and computer codes for electric guns; and provide requested workshops and continue support for IAT technical information center and apprenticeship program (1050)

Project BH64 - Materials Center of Excellence: This project establishes long term collaboration between ARL Materials Directorate and universities for the purpose of conducting world-class materials collaborative research relevant to Army needs. Basic research will be conducted to establish the scientific basis for creating and producing advanced materials to achieve higher performance, lower cost, improved reliability in Army unique system and component applications. A Broad Agency Announcement (BAA) was issued to solicit proposals under this effort. Specific efforts and funding cannot be provided at this time. The technical areas that will be addressed under this project are: degradation, reactivity and protection of materials; mechanical behavior of materials; synthesis and processing of materials; physical behavior of materials; high rate loading phenomena in materials.

FY 1994 Accomplishments: Work conducted in Project AH42, PE 0601012A (Defense Research Sciences).

FY 1995 Planned Program: Work conducted in Project AH42, PE 0601012A (Defense Research Sciences).

FY 1996 Planned Program:

- Conduct research in corrosion effects and protection of alloys (1485)
- Develop interface and high temperature property measurements in metal matrix composites (500)
- Develop non-destructive characterization of polymer matrix composite materials (1000)

FY 1997 Planned Program:

- Conduct research in corrosion effects and protection of alloys (1490)
- Develop interface and high temperature property measurements in metal matrix composites (500)
- Develop non-destructive characterization of polymer matrix composite materials (995)

Project BH65 - Microelectronics Center of Excellence: The Microelectronics Research Collaborative Program (MCRP) will establish a long term collaboration between ARL Physical Sciences Directorate and universities to ensure a seamless, synergistic cooperative work environment to provide the Army the key technologies and analytical support necessary to assure supremacy in future land warfare. The goals of this effort are to conduct innovative research and exploit new concepts in solid-state physics, electronics engineering and chemical/electrochemical engineering, and provide mutual exchange of public and private sector researchers working at each other's institutions in an "open lab" environment. The Cooperative Agreement process under the authority of 10 United States Code (USC) 2358, Research Projects, is currently

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underway and specific efforts and funding cannot be provided. The technical areas being addressed under this project are: Nanoelectronics/Optoelectronics; Electrochemistry/Energy Science; Biological/Chemical Detection; High Frequency and Quasi-optical Electronics; Piezoelectronics; Microelectromechanics.

FY 1994 Accomplishments: Work conducted in Project AH47, PE 0601102A (Defense Research Sciences)

FY 1995 Planned Program: Work conducted in Project AH47, PE 0601102A (Defense Research Sciences)

FY 1996 Planned Program:
- Conduct dual-use research in the electro-chemistry of new batteries and fuel cells (1485)
- Develop components and techniques for ultra-low-power electronics (750)
- Research process and manufacturing science for hither-quality affordable electronics (750)

FY 1997 Planned Program:
- Conduct dual-use research in the electro-chemistry of new batteries and fuel cells (1485)
- Develop components and techniques for ultra-low-power electronics (750)
- Research process and manufacturing science for hither-quality affordable electronics (750)

Project BH73 - Automotive Center of Excellence: 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: the University of Michigan, University of Iowa, University of Wisconsin, Wayne State University, and Howard University, while key industry partners include the "Big Three" U.S. automotive manufacturers.

FY 1994 Accomplishments: Work conducted in Project AF22, PE 0601102A (Defense Research Sciences)

FY 1995 Planned Program: Work conducted in Project AF22, PE 0601102A (Defense Research Sciences)

FY 1996 Planned Program:
- Conduct university research of automotive technologies as directed by the National Automotive Center University Research Initiative program manager (2985)

FY 1997 Planned Program:
- Conduct university research of automotive technologies as directed by the National Automotive Center University Initiative program manager (3075)

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B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	5707	5050	8174	9779
Appropriated Value	5707	8617		
Adjustments to Appropriated Value	-89			
SBIR/STTR Decrement (-89)				
Current President's Budget Submit	5618	8617	62715	61855

The substantial increase in funding from FY95 to FY96 represents a zero sum transfer of funding within the basic research program to support the creation of the Federated Laboratory.

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602105A Materials Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 200. Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	19370	24913	10176	10872	11616	12149	11591	11889	Continuing	Continuing
AH69 Cast Ductile Iron	1969	9865	0	0	0	0	0	0	0	11834
AH84 Materials	17401	15048	10176	10872	11616	12149	11591	11889	Continuing	Continuing

A. Mission Description and Budget Item Justification This program element provides the technical foundation for materials technology in metals, ceramics, polymers, and composites essential for the optimum use of these materials in all future Army systems. It also provides the technology base required for solving materials-related problems in existing fielded systems. The project addresses Army specific technologies to increase and sustain survivability and lethality of current and future Army unique systems in aircraft, missiles, armaments, ground and combat vehicles, combat service, and personnel support equipment for the soldier system. Development efforts are focused in Armor/Anti-armor materials, as well as lightweight structural materials and materials affording protection against chemical, biological or directed energy threats Areas of study in these developments are in characterization, to include high-strain rate characterization, processing, and fabrication of these materials. Additional efforts provide materials solutions for improved performance, durability, and cost reduction in Army unique systems. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project AH69 - Cast Ductile Iron: This project is a congressionally directed program for ductile iron technology research to reduce component costs and weight.

FY 1994 Accomplishments:

- Conducted field vehicle test of XT166 hybrid track. (256)
- Evaluated material and producibility refinements. (183)
- Completed design analysis and refinements for Abrams T158LL, Bradley T157I, Palladin/FAASV T154, and CAV lightweight track systems. (373)
- Established property data base for austempered ductile cast iron, ballistic and mechanical property testing, and metallurgical consulting at TACOM. (357)
- Developed Thermomagnetic Analyzer equipment to nondestructively analyze the transformation of ductile iron; conducted low temperature and high strain rate effects on Austempered Ductile Iron (ADI); performed process composition studies to determine alloy effects on mechanical properties; determined weldability of ductile iron; established R&D teaching microfactory to encourage cooperative research with the services and the metalworking industry; established Cooperative Research and Development Agreement with the University of Northern Iowa; and developed Army Ductile Iron program strategic plan. (800)

FY 1995 Planned Program:

- Perform qualification testing of T158LL, T157I, and T154 track systems. (6000)
- Build and test developmental lightweight track for CAV ATD. (1200)
- Complete material and producibility analyses. (2458)

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- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (207)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project AH84 - Materials: This program provides the technical foundation for providing necessary materials technology in metals, ceramics, polymers, and composites for Army systems. The efforts address technologies required to meet increased performance, reliability and survivability demands of current and future systems in aircraft, armaments, missiles, ground vehicles, combat support and personnel support equipment. Cost reduction is addressed through materials manufacturing/processing developments. Congressional adds to this project in FY 1994 and FY 1995 have financed the development of composite structures to be used on high performance missile systems.

FY 1994 Accomplishments:

- Conducted technical evaluation of composite armored vehicle demonstration contractor proposals, and developed and integrated materials and structures technology into Army Research Laboratory (ARL) programs. (750)
- Optimized processing and bonding of advanced materials, specifically demonstrated Sensors Mounted as Roving Threats (SMART) weave techniques for monitoring resin flow and state of cure in processing of thick composite plates. (3978)
- Provided tandem array ceramic armor for defeat of combined medium caliber Kinetic Energy (KE) and hand-held high explosive anti-tank threats. (2392)
- Determined optimum alloying materials for tungsten with respect to adiabatic shear model. (350)
- Demonstrated improved wear corrosion resistance in aircraft materials using ion beam processes and corrosion resistant schemes for advanced magnesium aircraft components. (1950)
- Developed ceramics/metallics for high temperature applications, specifically, demonstrated high quality tailored ceramics for lightweight, wear-resistant components for heat engine/propulsion systems. (1000)
- Demonstrated flexible chemical resistant barrier coatings for clothing/shelters, Chemical Agent Resistant Coatings (CARC) with signature reduction attributes, and laser protective schemes for eye wear and sensors. (2291)
- Developed composites for extreme environments/performance; performed full-scale tests of two piece vectorable, multi-pivot point solid rocket motor nozzles. (4000)
- Developed advanced structural analyses and Non-Destructive Evaluation (NDE) program for complex geometry thick composite structures and analyzed strength tests of thick curved sections. (690)

FY 1995 Planned Program:

- Develop a tungsten-based material that performs as well as depleted uranium in model scale ballistic testing. (440)
- Provide a new military specification on low cost titanium alloys for armor applications. (2670)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602105A Materials Technology

- Fabricate thin film alumina barium strontium titanate composites for phase shifter applications in radar antenna; develop laser barrier and signature reflective coatings for goggles and windshields. (1440)
- Provide technical support Composite Armored Vehicle (CAV) demonstration; develop and evaluate novel composite materials for ground vehicles. (1810)
- Optimize dry ion beam treatments as environmentally acceptable alternatives to specific cadmium/chromium electroplating applications; develop multi-functional protective coatings. (2229)
- Demonstrate potential of SMART weave sensor grid for real time monitoring of composite parts during service. (1785)
- Perform tests and analyses on thick composite structures to support integrated stress-strength-inspection technology for composite structures. (709)
- Complete fabrication, initial testing, and characterization of quartz phenolic and carbon-carbon missile nosetips. (3965)

FY 1996 Planned Program:

- Fabricate and evaluate ballistically tolerant components for rotary wing aircraft; develop a database of dynamic responses, residual strength properties for new composite armors; develop a new ceramic armor breast and back plate for an ultra lightweight personnel armor to defeat small arms projectiles. (2811)
- Correlate dynamic finite element analysis and modal testing data of undamaged and damaged helicopter tail booms. (1646)
- Develop modeling, hardware and design data base for life prediction and deterioration control of polymers in plastics, rubbers, coatings, and composite/hybrid materials. (2714)
- Develop intelligent imaging systems for non-destructive evaluation (NDE) of electronic components. (1714)
- Establish criteria for prevention/mediation of the effect advanced propellants have on conventional and improved gun systems. (639)
- Evaluate stress-strength-inspection test and analysis results for thick composite structures to define integrated structural integrity design criteria. (652)

FY 1997 Planned Program:

- Develop material systems based on a combination of ceramics, intermetallics, composites, and metal hybrids for use in advanced armor systems; investigate alternative warhead materials to replace heavy metal penetrators. (2638)
- Investigate novel approaches to combining low cost titanium and other lightweight materials for incorporation into future army systems. (1876)
- Demonstrate improved protective coatings, including chemical agent resistant coating, meeting all military requirements for ground support equipment, aircraft, and ammunition. (3432)
- Combine sensor based manufacturing techniques and on-board life monitoring for use in manufacture of composite components with greater logistic supportability. (1700)
- Demonstrate gun tube life enhancement by using protection schemes developed to reduce the attack of advanced propellant systems on conventional and improved gun systems. (530)
- Validate integrated structural integrity design criteria for thick composites and transition results to the ground vehicle industry. (696)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602105A Materials Technology

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	17274	11083	10163	10684
Appropriated Value	17274	24913		
Adjustments to Appropriated Value	2096			
a. SBIR/STTR decrement (-35)				
b. Reprogramming (+2131)				
Current President's Budget Submit	19370	24913	10176	10872

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DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602105A Materials Technology

PROJECT: AH69

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH69 Cast Ductile Iron	1969	9865	0	0	0	0	0	0	0	11834

C. **Other Program Funding Summary:** N/A

D. **Schedule Profile:** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Materials Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602105A Materials Technology

PROJECT: AH84

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH84 Materials	17401	15048	10176	10872	11616	12149	11591	11889	Continuing	Continuing

C. **Other Program Funding Summary**: N/A

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent exploratory development in the area of materials technology, therefore no milestones are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602120A Sensors & Electronic Survivability

COST (*In Thousands*)		FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	33124	26973	21918	23879	25587	28034	28254	29889	Continuing	Continuing
AH15	Ground Combat Identification Technology	4601	4085	3615	3783	3828	3927	3928	4030	Continuing	Continuing
AH16	Sensor, Signatures, Signal and Information Processing (S3I) Technology	17641	11988	11162	12491	12981	14734	15324	16625	Continuing	Continuing
AH25	Nuclear Effects Survivability and Fuzing Technology	5019	5121	4576	4903	5937	6324	5949	6102	Continuing	Continuing
A140	High Power Microwave (HPM) Technology	5863	5779	2565	2702	2841	3049	3053	3132	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objectives of this program are: first, to provide sensor, signal and information processing technology for advanced Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA), 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, second, to determine and reduce the susceptibility and vulnerability of Army equipment and systems to nuclear and Radio Frequency (RF)/High Power Microwave (HPM) environments. Four critical technologies are addressed to increase the combat effectiveness of tactical Army Forces: (1) High Power Microwave (HPM) technology; (2) Combat Identification technology; (3) Sensors, Signatures, Signal and Information Processing (S3I) technology; (4) Nuclear Effects Survivability 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. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project AH15 - Ground Combat Identification Technology: This program provides the enabling technology necessary to demonstrate advanced Combat Identification concepts and systems for all aspects of ground combat. The hardware and software improvements and modeling and simulation advances provided by this project are essential to ensure needed advancements in point-of-engagement target identification (ID) and accurate, timely situational awareness (SA). The operational impact is a significant increase in combat effectiveness as well as reduced fratricide. CI is a key element of the Army's larger objective of Battlefield Digitization and synergistically supplements that effort by feeding friendly and hostile positional information from the platform level into the command and control network.

FY 1994 Accomplishments:

- Initiated construction of prototype, cooperative target ID devices for dismounted soldier application. (1588)
- Completed initial field testing and demonstration of low cost infrared embedded signature technology. (400)
- Completed initial assessment of non-cooperative aided/automatic target ID technology. (1300)

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- Developed preliminary engineering models for advanced target ID techniques and completed investigations of Forward Looking Infrared (FLIR) ID modeling and performance improvements. (1313)

FY 1995 Planned Program:

- Complete system performance modeling of alternative combat ID concepts for the Ground-to-Ground platform application and preliminary modeling of candidate Air-to-Ground concepts. (1000)
- Begin development of constructive modeling tools for combat ID for the dismounted soldier. (200)
- Complete virtual simulation of Enhanced Battlefield Combat ID System capability to provide highly accurate Situation Awareness (SA) information at platoon level and higher and link into advanced C3 systems. (1650)
- Complete construction of conceptual target ID equipment for dismounted soldier and support Dismounted Battlespace Battle Lab field experimentation. (1153)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (82)

FY 1996 Planned Program:

- Complete initial force-on-force modeling of candidate Air-to-Ground combat ID systems and candidate systems for the dismounted soldier. (500)
- Continue constructive modeling of advanced non-cooperative target ID concepts to provide enhanced hostile ID capability. (500)
- Complete initial virtual simulations of candidate Air-to-Ground combat ID systems and begin development of tools for simulation of CI alternatives for the dismounted soldier. (1800)
- Begin experimental investigations and field data collection with candidate sensor technologies for enhanced friend and foe target ID. (815)

FY 1997 Planned Program:

- Complete constructive modeling and virtual simulations of Air-to-Ground CI systems and initial simulations of dismounted soldier combat ID. (1000)
- Complete exploration of advanced technologies for enhanced target ID. (1783)
- Perform initial data collection and analysis of performance against targets with suppressed signatures. (1000)

Project AH16 - Sensors, Signatures, Signal and Information Processing (S3I) Technology: This project provides for the synergistic development of sensors, signal and information processors, and Automatic Target Recognition (ATR) technology for RISTA, fire control, smart munitions and fuzing systems. In the RISTA and fire control area, the project will develop and demonstrate: (1) advanced Ultra Wide Band (UWB) radar technology for adverse weather, wide-area detection, location and recognition of tactical ground targets concealed in foliage, and buried mines; (2) innovative algorithms for the detection, discrimination, and classification of stationary targets from a low flying helicopter; (3) ATR algorithms that synergistically use outputs of Forward Looking Infrared (FLIR), Millimeter Wave (MMW) Radar and Laser Radar (LADAR) sensors to identify combat vehicles and perform signature predictions in many bands (infrared, visible, MMW, and LADAR) from targets and backgrounds at specified times, weather conditions and locations; (4) affordable, lightweight target acquisition radar technology for man-portable and battlefield platform applications: (5) advanced optical processing techniques to automatically process, at the sensor, the received signals into target information of sufficiently narrow

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bandwidth to be compatible with Army communication systems. Project goals in the smart munitions and fuzing sensor area include development of advanced microwave, millimeter wave (MMW), acoustic, electrostatic, and LADAR technologies and reliably sense low-cross section targets in high countermeasures and clutter environments.

FY 1994 Accomplishments:

- Developed a low depression angle real aperture radar clutter data base, and developed procedures for embedding targets in the clutter. Developed innovative target/clutter discriminants using this data. (2303)
- Develop the first iteration of a specific detection logic and insert an advanced Analog/Digital (A/D) converter to improve the UWB foliage penetration (FOPEN) Synthetic Aperture Radar (SAR) testbed (to be completed in FY 1995). (3800)
- Demonstrated two-dimensional optical processing for SAR and wideband radar; demonstrated in the lab a range-doppler processor for the Missile Command (MICOM) Multi-Role Survivable Radar (MRSR) and demonstrated the optical pulse compressor for the Communications-Electronics Command (CECOM) Electronic Support Measures (ESM) testbed. (2300)
- Developed target engagement sensor technologies including Global Positioning System (GPS), and electrostatic sensor technologies. (1305)
- Demonstrated the smart mine testbed with advanced acoustic algorithms and designed a multi-sensor capability into the testbed. (941)
- Developed FLIR and LADAR sensor/target simulation and ATR algorithms and evaluated its performance against a set of 10 different target types. (716)
- Evaluated improved models and sensor designs for air and ground target engagements. (1319)
- Constructed an advanced transceiver which can support multiple modes such as wide area surveillance, track while scan, and enhanced vehicle classification for use in man-portable and vehicle-mounted radars for battlefield applications. (957)
- Develop technologies for passive MMW camera and line scanner (to be completed in FY 1995). (4000)

FY 1995 Planned Program:

- Characterize targets and clutter using UWB SAR data and use to develop target/clutter discriminants; complete transportable testbed to characterize sub-surface targets such as mines. (1377)
- Demonstrate digital pulse compression, investigate digital inphase/quadrate phase demodulation and demonstrate digital phase control of direct digital synthesizer to compensate for transceiver phase errors for the detection of moving and stationary targets. (872)
- Develop neural-net based stationary target/clutter discriminator and test on existing radar database. Identify alternate target clutter algorithm architectures. (1841)
- Integrate a range doppler processor into the Missile Command (MICOM) Multi-Role Survivable Radar (MRSR) testbed and begin performance testing, and develop algorithms and implementation architectures for interfacing wide band optical correlation processors to radar signal processing for the Communications-Electronics Command (CECOM) Electronic Support Measures (ESM) testbed. (2022)
- Demonstrate improved multi-sensor ATR algorithms to expand the ATR operation envelope, and increase performance by further emphasizing target signature differences. (1039)
- Develop enhanced target engagement sensor technologies, including microwave, electrostatic, and GPS for future Army systems. (1407)
- Develop MMW and electro-optic breadboards and modeling technologies needed for the development of improved target acquisition, tracking, and endgame engagement techniques. (985)

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- Incorporate acoustic, seismic and other sensor capabilities in the smart mines and integrated soldier testbeds; develop and evaluate sensing and recognition algorithms for vehicle, unattended and soldier platforms. (972)
- Design terrain and environmental spatial database and tactical event detection/synchronization software. (1221)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (252)

FY 1996 Planned Program:

- Develop refined automatic detection capability for concealed targets using UWB SAR data by exploiting unique phenomenology; conduct measurements program on near surface metal and plastic mines using transportable testbed. (1354)
- Perform efficient multi-mode waveform processing, using direct digital synthesis and open architecture signal processing; quantify cost savings for future systems. (1220)
- Develop advanced target/clutter separation techniques for RISTA and fire control radar applications based on use of neural net and genetic training techniques; evaluate concepts for self-regulating algorithm to sense cluttered background. (1953)
- Test and characterize the ambiguity optical processor and develop algorithms and architecture for the MRSR testbed. (1771)
- Add MMW radar data as the second sensor for ATR algorithms; develop new 10 class model based multi-sensor recognition algorithms; and investigate the performance and data requirement issues related to a SAR/thermal image multi-sensor ATR. (853)
- Develop low cost, enhanced target engagement sensor technologies, including microwave, electrostatic and GPS for future Army systems; develop design of GPS receiver suitable for projectile firing (very high gravity environment). (1392)
- Develop a testbed to quickly analyze acoustic data and facilitate generation of acoustic algorithms and demonstrate real time tracking and identification of targets for application to vehicle, unattended and soldier platforms. (1042)
- Investigate techniques for providing near-field target signature by purely analytical means; evaluate MMW radar tracking algorithms for armored targets at extended ranges. (973)
- Integrate the terrain and environmental reasoning spatial database and tactical event detection and synchronization server laboratory testbed. (604)

FY 1997 Planned Program:

- Provide initial transition of foliage penetration (FOPEN) technology to receiving Research, Development, and Engineering Center (RDEC) by supplying point design for FOPEN radar with supporting algorithms; perform characterization of sub-surface mine signatures. (1292)
- Implement advanced waveform processing in software and benchmark; evaluate adding advanced Moving Target Indication (MTI) and Stationary Target Indication (STI) algorithms to processor suite. (1512)
- Test advanced real beam radar target/clutter separation techniques in end-to-end algorithm evaluation facility and provide report; apply data compression techniques to signature storage to enhance vehicle classification capability; test self-regulation concepts on diverse clutter data. (2149)
- Develop algorithms and architectures for image processing and demonstrate two-dimensional optical processors showing high throughput image signal processing. (1992)

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- Extend performance envelope of the FLIR/MMW model-based algorithm to more difficult scenarios: 10-20 class, moderate to heavy clutter, up to 40% occlusion; initiate development of multi-sensor SAR/thermal images ATR. (987)
- Develop enhanced target engagement sensor technologies, including microwave, electrostatic and GPS for future Army systems; assess sensitivity of electrostatic sensing fuzing algorithms to electronic countermeasures and incorporate appropriate changes. (1667)
- Expand acoustic real time tracking and identification to include a broader base of targets for application to vehicle, unattended and soldier platforms. (1208)
- Develop an initial version of a target signature generator which will accept as user inputs sensor parameters, target description and sensor-to-target geometrics; extend MMW radar track accuracy measurements to armored targets in defilade and helicopters in trees. (1071)
- Demonstrate selected multi-level reasoning applications on a scaleable processing environment and provide software engineering support documentation and software transition/integration support. (613)

Project AH25 - Nuclear Effects Survivability Technology: This project develops and provides nuclear weapons effects survivability technology for designing, producing, and fielding tactical systems and equipment for the Army and other military services in accordance with the Tri-Service Reliance Agreements on Nuclear Weapons Effects. The goals are to understand new weapons phenomena and the response of new emerging technologies to nuclear weapons effects, to develop new techniques for mitigating the response of new emerging technologies to nuclear weapons effects, and to develop new methods for analyzing and simulating the effects in order to reduce the costs for achieving nuclear survivability. This project will provide cost effective solutions for the rapidly growing threat of nuclear weapons technology proliferation in the Third World.

FY 1994 Accomplishments:

- Completed calculations to determine radiation protection in Advanced Field Artillery System, to predict low altitude source region electromagnetic pulse (EMP), and to model EMP terminal protection device performance. (1400)
- Improved survivability technologies by developing a radiation hardened ferroelectric non-volatile memory integrated circuit, testing application-specific integrated circuits and characterizing a laboratory scale blast simulator. (1266)
- Developed analytical methods and experimental facilities to characterize electromagnetic shielding properties of composite structures and radiation response physics of silicon carbide semiconductors. (1120)
- Defined the non-ideal nuclear airblast threat to tactical Army systems deployed on desert terrain. (474)
- Improved investigative techniques for Nuclear, Biological, Chemical/Smoke and Obscurants threat effects on equipment and personnel. (759)

FY 1995 Planned Program:

- Calculate nuclear radiation protection and electromagnetic shielding effectiveness of a composite armored vehicle. (1068)
- Identify state-of-the-art commercial electronic components that can be used to meet nuclear survivability requirements and develop guidelines for designing radiation hardened integrated circuits. (1377)
- Evaluate the electromagnetic shielding characteristics of candidate composite materials and a prototype composite electronic equipment shelter. (1173)
- Demonstrate the ability to simulate the non-ideal nuclear airblast and test the effects on Army vehicles. (518)

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- Improve algorithms to insert chemical, biological, and nuclear impact into conventional weapon effects models. (985)

FY 1996 Planned Program:

- Develop test methodologies for radiation survivability of advanced commercial integrated circuits, new Static Random Access Memories (SRAMs) and, using the Scale Model EM Facility, for composite structures. (1273)
- Examine non-linear materials as potential smart composite shield materials and demonstrate composite shielding concept. (1215)
- Calculate radiation shielding effectiveness for a composite armored vehicle and calculate internal blast on Massively Parallel Processing (MPP) computers. (896)
- Determine non-ideal blast parameters for use in nuclear survivability criteria and specify techniques that will mitigate non-ideal blast effects on personnel
- and equipment. (560)
- Update working version of nuclear blast codes from experiments and computer analysis design tools. (632)

FY 1997 Planned Program:

- Perform computations to evaluate radiation shielding design of the Advanced Field Artillery System (AFAS) and to develop new criteria for EMP on Army systems. (848)
- Develop guidance for designing radiation resistant Application Specific Integrated Circuits (ASICs), EMP hardened composite shelters, and modeling Fuel/Air Explosive (FAE) detonations. (1501)
- Evaluate advanced materials for survivability enhancement, including light, low fatigue electromagnetic shielding materials and magnetoresistive non-volatile memories. (1266)
- Perform drag coefficient mitigation studies to reduce vulnerability of tactical vehicles to non-ideal blast drag loading. (537)
- Develop prediction methodology for smoke effects on Army systems. (751)

Project A140 - High Power Microwave (HPM) Technology: The objective of this project is to develop the tools, techniques and methodology to assess the susceptibility and vulnerability of Army equipment and systems to various types of Radio Frequency (RF)/High Power Microwave (HPM) environments, and to identify and evaluate the technology required to protect and harden U.S. equipment.

FY 1994 Accomplishments:

- Conducted HPM susceptibility assessments (through testing and analyses) of foreign and US Army assets including munitions, communications equipment and avionics to support Advanced Technology Demonstrations (ATDs) and Advanced Concept Technology Demonstrations (ACTDs). Five successful field tests were conducted. (3763)
- Conducted HPM hardening technology development and demonstrations centering on Silicon Carbide technology and a joint program for Monolithic Microwave Integrated Circuit (MMIC) hardening initiated with United States Army Space and Strategic Defense Command (USASSDC). (900)

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- Developed HPM tools (sources/components) for indoor/outdoor experimentation including antennas and pulsed power amplifiers with a focus on the interference modulator for laboratory use in FY 1995. Completed field test sources to support ATD testing. Completed Backward Wave Oscillator (BWO) source design and construction. (1200)

FY 1995 Planned Program:

- Conduct HPM susceptibility assessments (through testing and analysis) of foreign and US Army assets including munitions, communications equipment and avionics to support ATDs and ACTDs. (3359)
- Conduct HPM hardening technology development and demonstrations centering on 21st Century Land Warrior helmet and the GPS system. (900)
- Develop HPM tools (sources/components) for indoor/outdoor experimentation including antennas and pulsed power amplifiers with a focus on the interference modulator for laboratory use in FY 95, completed final testing of the BWO for transition to TECOM and begin development of a wideband Klystron amplifier for use in the out years. (1398)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (122)

FY 1996 Planned Program:

- Conduct limited HPM susceptibility assessments (through testing and analysis) of foreign and US Army assets including munitions, communications equipment and avionics to support ATDs and ACTDs. (1676)
- Conduct HPM hardening technology development and demonstrations centering on completion of MMIC on-chip limiters for USASSDC and other selected systems. (500)
- Develop HPM tools (sources/components) for indoor/outdoor experimentation including antennas and pulsed power amplifiers with a focus on development of the wideband Klystron amplifier. Deliverables will be progress report and journal publication. (389)

FY 1997 Planned Program:

- Conduct HPM susceptibility assessments (through testing and analyses) of foreign and US Army assets including munitions, communications equipment and avionics to support ATDs and ACTDs. (1802)
- Conduct HPM hardening technology development and demonstrations centering on technology to protect US assets on the digital battlefield. Focus will be on Silicon Carbide (SiC) technology and electro-optic limiters. (500)
- Develop HPM tools (sources/components) for indoor/outdoor experimentation including antennas and pulsed power amplifiers with a focus on the completion of design for a wideband Klystron amplifier for laboratory use. Deliverables will be progress report and journal publication. (400)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602120A Sensors & Electronic Survivability

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY1997
Previous President's Budget	34708	26036	22376	23616
Appropriated Value	34708	26973		
Adjustments to Appropriated Value	-1584			
a. SBIR/STTR decrement (-434)				
b. Reprogramming (-1150)				
Current President's Budget Submit	33124	26973	21918	23879

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602120A Sensors & Electronic Survivability PROJECT AH15

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH15 Ground Combat Identification Technology	4601	4085	3815	3783	3828	3927	3928	4030	Continuing	Continuing

C. **Other Program Funding Summary**: N/A

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Ground Combat Identification Technology, therefore no milestones or events are provided.

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602120A Sensors & Electronic Survivability		PROJECT: AH16

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH16 Sensor, Signatures, Signal and Information Processing (S3I) Technology	17641	11988	11162	12491	12981	14734	15324	16625	Continuing	Continuing

C. Other Program Funding Summary N/A

D. Schedule Profile The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Sensor, Signatures, Signal and Information Technology, therefore no milestones or events are provided.

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DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602120A Sensors & Electronic Survivability

PROJECT: AH25

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH25 Nuclear Effects Survivability and Fuzing Technology	5019	5121	4576	4903	5937	6324	5949	6102	Continuing	Continuing

C. **Other Program Funding Summary** N/A

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Nuclear Effects Survivability and Fuzing Technology, therefore no milestones or events are provided.

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602120A Sensors & Electronic Survivability / PROJECT: A140

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A140 High Power Microwave (HPM) Technology	5863	5779	2565	2702	2841	3049	3053	3132	Continuing	Continuing

C. **Other Program Funding Summary** N/A

D. **Schedule Profile**: The efforts funded in this project are non-system specific and represent exploratory development in the area of High Power Microwave (HPM) Technology, therefore no milestones are provided.

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DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602211A Aviation Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	34570	19962	20381	26045	28100	30730	30135	33034	Continuing	Continuing
AH85 Aircraft Avionics Technology	6897	0	0	0	0	0	0	0	0	6897
A47A Aeronautical and Aircraft Weapons Technology	23004	16672	17732	23294	25212	27636	27037	29658	Continuing	Continuing
A47B Vehicle Propulsion and Structures Technology	4669	3290	2649	2751	2888	3094	3098	3376	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objective of this program element (PE) is to develop aeronautical technology for new and/or upgrades to DoD/Army Vertical Take-off and Landing (VTOL) airmobile systems. Helicopter rotors provide low disc loading as compared to the tilt rotor's intermediate disc loading and vertical lift jet engine's high disc loading. Low disc loading VTOL aircraft offer a practical solution to many of the DoD/Army's operational needs. Such aircraft, with their ability to operate below tree top level for Nap-of-the-Earth (NOE) missions, present significantly different analysis and design challenges from traditional fixed wing aircraft which fly at higher altitudes. The Army Aviation Science and Technology program's functional organization, with assistance from National Aeronautics and Space Administration (NASA) at three co-located activities, are the focal points for US efforts in rotorcraft technology. Technical areas include aeromechanics, aerodynamics, aeroacoustics, structures, propulsion, reliability and maintainability, safety and survivability, mission support equipment, aircraft system synthesis, aircraft subsystems, advanced helicopter analysis, flight simulation, aircrew-aircraft integration, aircraft weapons, aircraft avionics for command and control, air-to-air/air-to-ground communications, controls and displays, digital avionics and architectures, NOE navigation, mission planning, air traffic management and investigation and selective application of Integrated Product and Process Development (IPPD) techniques. These technologies are continuously being researched for applications to improve and correct deficiencies in current DoD/Army VTOL aircraft 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, and DoD Project Reliance agreements. Beginning in FY 1997, this PE will finance dual-use technology development in cooperation with industry through the establishment of a National Rotorcraft Technology Center (NRTC). The NRTC will be a cooperative, joint Army, NASA, FAA, academia, and industry effort for cooperative R&D on technologies critical to U.S. rotorcraft military and economic competitiveness and to address the full spectrum of rotary wing vehicle technologies and concepts for dual-use applications. The approach will be similar to the highly successful National Automotive Center at the U.S. Army Tank Automotive and Armaments Command (TACOM). Projects in this PE include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Work in this PE is performed by contractors including McDonnell Douglas Helicopter Systems, Mesa, AZ; Boeing Helicopter Company, Philadelphia, PA; Bell Helicopter Textron Incorporated, Ft. Worth, TX; Northrop Grumman Corp., Bethage, NY; General Electric, Lynn, MA; Allied Signal - Lycoming Engines Div., Stratford, CT; Allied Signal Engines, Phoenix, AZ; Sikorsky, Stratford, CT; Allison Gas Turbine, Indianapolis, IN; Rolls Royce, Atlanta, GA; Kaman Aerospace Corp., Bloomfield, CT; Piasecki Aircraft Corp., Essington, PA; Technology Integration Inc., Bedford, MA; Structural Integrity Associates, San Jose, CA., Simula, Phoenix, AZ., Lucas Western, City of Industry, CA, Vetronics, Bedford, MA., Georgia Tech Research Institute, Atlanta, GA; Sterling Federal Systems Inc., Palato, CA; Navajo, San Jose, CA; Institute of Medical Cybernetics Inc., Potomac, MD; SRI/David Sarnoff Research Center, Princeton, NJ; BDM International, Albuquerque, NM; MITRE, McLean, VA; Intermetrics, Wall Township, NJ; and Charles Stark Draper Laboratory, Cambridge, MA.

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Primary in-house developers include Aviation and Troop Command (ATCOM), St. Louis, MO; Aeroflightdynamics Directorate/ATCOM, NASA Ames Research Center, Moffett Field, CA; Aviation Applied Technology Directorate/ATCOM, Ft Eustis, VA; Vehicle Structures Directorate/Army Research Laboratory (ARL), NASA Langley Research Center, Hampton, VA; Vehicle Propulsion Directorate/ARL, NASA Lewis Research Center, Cleveland, OH; and Communications-Electronics Command (CECOM), Ft. Monmouth, NJ. Related activities are performed by National Aeronautics and Space Administration.

This program adheres to Tri-Service Reliance Agreements on Aeropropulsion and Air Vehicles (Rotary) with oversight and coordination provided by the Joint Directors of Laboratories. Related technology demonstrations are conducted under PE 0603003A (Aviation Advanced Technology). Work in this Program Element contains no unwarranted duplication of effort among the Military Departments. Joint coordination of efforts where applicable is conducted with National Aeronautics and Space Administration (NASA) Low Speed Aircraft Research and Technology; PE 0602122N, Aircraft Technology; and PE 0602201F, Aerospace Flight Dynamics. Coordination to eliminate unnecessary duplication is accomplished by joint program reviews, exchange of program data sheets, research and technology resumes, technical reports; inter-service liaison; attendance at scientific meetings and conferences; joint participation in The Technical Cooperation Program (TTCP), NASA Research and Technology Committees, and the North Atlantic Treaty Organization (NATO) Advisory Group on Aerospace Research and Development (AGARD). Efforts under this PE transition and provide risk reduction for Demonstration/Validation and Engineering Development programs supported by PE 0603801A (Aviation - Advanced Development), PE 0604801A (Aviation - Engineering Development) and PE 0604270A (Electronic Warfare Development). Some efforts also transition to the field through PE 0203752A (Aircraft Engine Component Improvement Program). In addition, this PE's deliverables provide technical support to PE 0604223A (RAH-66 Comanche), PE 0604816A (Longbow), and PE 0203744A (Aircraft Modifications/Product Improvement). Active joint Service programs include: the Army/NASA aided pilotage program, Air Force/Army Real Time Artificial Intelligence System (RTAIS); the Tri-Service Multi-mode Navigation/Communication Microstrip Antenna and Covert Communications program; the Tri-Service Integrated High Performance Turbine Engine Technology program. International Cooperative Agreements include Information Exchange on Engine Environmental Protection under the Master Information Exchange Agreement IEA-A-94-UK-1425 titled Advanced Tactical Helicopters and Associated Technology.

Project AH85 - Aircraft Avionics Technology: The objective of this project is the exploration of new concepts and techniques in aviation electronics to achieve new and enhanced military functional capabilities. Emphasis is on aided pilotage, mission planning, precision navigation, nap of the earth communications, and integration with the evolving digital command and control battlefield. New enabling technologies which support current thrusts are also explored, such as aircraft controls and displays, voice interactive technology, fault tolerant processing, real time artificial intelligence processing, covert communication technologies, data communication, and advanced open system architectures and integration concepts.

FY 1994 Accomplishments:

- Augmented aided pilotage flight path guidance algorithm with laser radar obstacle avoidance sensor and integrated radar deception and jamming (RD&J) pod into aided pilotage aircraft (3736)
- Augmented aircraft mission route rehearsal software with terrain visibility algorithms and developed software to integrate satellite imagery with perspective view generation (992)
- Completed definition of nap of the earth flight path guidance display and evaluated color helmet mounted display symbology (593)
- Completed definition for high integrity database for precise terrain/obstacle registration and integrated GPS reference receiver into precision navigation configuration (1544)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602211A Aviation Technology

- Evaluated commercial video compression technology for application to airborne platforms (32)

FY 1995 Planned Program: Project transitions to PE 0602782A, Project A779.

FY 1996 Planned Program: Project transitions to PE 0602782A, Project A779 in FY1995.

FY 1997 Planned Program: Project transitions to PE 0602782A, Project A779 in FY1995.

Project A47A - Aeronautical and Aircraft Weapons Technology: The purpose of this project is to conduct exploratory development of technologies for DoD/Army VTOL airmobile systems improvements in operational effectiveness and combat mission capability including air-to-air combat, higher tactical mobility, increased strategic mobility, improved fire power, use of special weapons and increased combat sustainability. Work in this project maintains world excellence in rotorcraft technology through the study of advanced technologies and their applications to rotorcraft. Areas of investigation and research consist of the following: fluid mechanics, dynamics, aerodynamics, advanced flight control technology; handling qualities, aircraft and weapons interaction; acoustics and signature reduction, weight reduction; advanced materials applications; internal/external loads; militarization of propulsion/structures technology, engine specific component technologies in support of the DoD Integrated High Performance Turbine Engine Technology (IHPTET) initiative goal demonstrators, advanced smart materials applications; flight simulation; improved soldier machine integration and pilot-vehicle interface, improvements in reliability and maintainability, combat damage repair of new materials, survivability/vulnerability to new threats, crashworthiness, and logistics. These technologies are being developed for application to current as well as future DoD/Army rotorcraft systems. Beginning in FY 1997, this PE will finance dual use technology development in cooperation with industry through the establishment of a National Rotorcraft Technology Center (NRTC). The NRTC will be a cooperative, joint Army, NASA, FAA, academia, and industry effort for cooperative R&D on technologies critical to U.S. rotorcraft military and economic competitiveness and to address the full spectrum of rotary wing vehicle technologies and concepts for dual-use applications.. The approach will be similar to the highly successful National Automotive Center at the U.S. Army Tank Automotive and Armaments Command (TACOM).

FY 1994 Accomplishments:

- Completed aircraft integration and effectiveness studies of the Navy's Advanced Rocket System (ARS); supported Joint ARS Cost and Operational Effectiveness Analysis and initiated Non-Lethal Weapons (NLW) for Rotorcraft Investigation and Low Cost Precision Kill (LCPK) Studies (1614)
- Initiated handling qualities criteria and cueing technique development for cargo class helicopters for night slung load operations; analyzed advanced flight control reconfiguration concepts; documented flight control law design techniques for highly augmented helicopters; demonstrated via simulation an expanded concept for integrating rotorcraft flight, fuel, and fire control subsystems; and initiated Rotorcraft-Aircrew Systems Concept Lab (RASCAL) control system procurement (1998)
- Developed modular analysis/prediction methods for rotor wake, multi-rotors, acoustics, and aerodynamic interference; conducted first test of model High-Lift Rotor, explored low-cost vibration reduction techniques and developed individual blade control methodologies; completed Second Generation Comprehensive Helicopter Analyses System Version 2.3 (3591)
- Completed development and bench test demonstration of the Holometrics flight loads determination method; installed improved erosion systems on AH-1 main rotor blades for field evaluation; and completed design of a resin transfer molded wing spar and thermoplastic tailboom section and horizontal stabilizer (3177)

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- Completed engine testing of composite inlet housing effort on Titanium Aluminum (TiAl) diffuser and conducted aerodynamic testing of low inertia turbine design (1152)
- Completed design of reprogrammable Smart Integrated Micro Sensor, began assembly and delivered prototypes to support structural test plan; completed laboratory testing of the improved rod end bearing and issued final report; completed the Turbine Engine Diagnostic System (TEDS) field maintenance survey; assessed diagnostic opportunities and proposed a series of diagnostic techniques to enhance field maintenance with a cost benefit analysis (1032)
- Defined three levels of enhanced NBC protection for five fleet rotorcraft and developed decontamination and maintenance requirements for the NBC requirements; developed enhanced comfort crew seat cushion for minimized fatigue and back pain; defined lighter weight opaque and transparent armor concepts (3155)
- Developed rotorcraft survivability analyses and models to define optimum cost/weight solutions for active/passive countermeasures and tactics to include reduced radar cross section via radar absorbing material/structures, and visual and electro-optical detection analysis model for rotorcraft visual and infrared signature reduction (1903)
- Developed simulation and analyses for potential "Dual Use" concepts including National Transport Rotorcraft (NTR), manned/unmanned vehicle integration, and low cost, reconfigurable mission equipment package architectures for military/civilian applications (1872)
- Completed 911 Dispatch Console Public Safety Cooperative Research and Development Agreement (CRDA); demonstrated MIDAS Phase VI results to industry; conducted MIDAS to optimize user interface incorporating advanced human models (2510)
- Provide funding to US Navy to initiate follow-on phase of the Advanced Rotorcraft Vectored Thrust Combat Agility Demonstrator program (to be accomplished in FY1995) (1000)

FY 1995 Planned Program:

- Evaluate rotorcraft integration concepts and performance (simulation) of The Army's Combined Arms Weapon System (TACAWS) missile, Low Cost Precision Kill (LCPK) concepts and Non-Lethal Weapons (NLW) for Rotorcraft (531)
- Complete development of flight test maneuvers and continue cargo/slung load helicopter handling qualities (HQ) development for hover, low speed and dense loads; evaluate visual and aural cueing techniques for carefree maneuvering; and develop control laws for in-flight simulation model "following" capability (2363)
- Develop hardware/software to support integration of flight, fuel, and fire control (IFFC) systems in preselected rotorcraft for flight test demonstration (308)
- Develop advanced rotor blade technologies supporting acoustic signature and vibration control techniques including low cost, high performance rotor designs for wind tunnel evaluation; couple computational fluid dynamics and acoustic prediction into aeromechanics analysis (1182)
- Complete fabrication and structural testing of a resin transfer molded wing spar and a thermoplastic horizontal stabilizer; complete fabrication and ballistic testing of a thermoplastic tailboom section (2008)
- Fabricate low inertia turbine; engine test organic matrix composite engine inlet housing; complete flight-weight magnetic bearing controls development, adaptive lube system analysis, innovative inlet protection system analysis and non-intrusive ignition demonstration (1117)
- Complete assembly and testing to validate the reprogrammable smart integrated microsensor system (664)
- Complete crashworthy thermoplastic structure laboratory demonstration and rotorcraft survivability analyses to define optimized cost/weight solutions of active/passive countermeasures/tactics; continue ongoing assessment of reduced radar cross section kit for radar absorbing materials/structures operational durability and conduct flight test program to validate visual-electro/optic detection analysis model (2826)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602211A Aviation Technology

- Continue development of simulation and analyses for potential "Dual Use" concepts including National Transport Rotorcraft (NTR), manned/unmanned vehicle integration, and low cost, reconfigurable mission equipment package architectures for military/civilian applications (2152)
- Add new operator task structures and behaviors and cognitive process display/output measures; transition to validation and demonstration of MIDAS code and transfer results to industry (3521)

FY 1996 Planned Program:

- Support ground testing and simulation of the TACAWS, LCPK and NLW for rotorcraft (1232)
- Extend slung load cargo handling qualities development to high speed and multi-point suspension; develop control limiting into cueing techniques for carefree maneuvering; initiate demonstration of full IFFC in a ground based systems integration facility; and initiate integration/checkout of RASCAL research flight control system (2816)
- Combine innovative rotor technologies and integrated aeromechanics analysis to quantify progress achieved in rotor performance, acoustics, and vibration control; merge the interdisciplinary tools to set the design direction for an advanced rotor/control system for the Helicopter Active Control Technology (HACT) demonstration (supports the NTR Program) (1180)
- Develop the system architecture for an advanced manufacturing process and tooling expert system and develop preliminary design concept for a damage tolerant hub flexure (2062)
- Conduct engine test of gamma titanium aluminum impeller diffuser and Army/Air Force non-intrusive ignition system and spin pit and rig test of low inertia turbine (1009)
- Investigate application of fuzzy logic as applied to aviation maintenance diagnostic methods, and initiate the development of an onboard weight and balance sensor for helicopter operations (622)
- Complete survivability analyses to define optimized cost/weight solutions for active/passive countermeasures; initiate investigations of helicopter susceptibility reduction to advanced sensors, and initiate investigation of large rotorcraft crashworthiness; initiate directed energy weapon hardening investigations (2953)
- Develop advanced manned and unmanned VTOL systems and operational concepts and identify areas of technology for further investigation (2272)
- Add model of auditory communications to MIDAS, and implement new user interface and single language simulation (3586)

FY 1997 Planned Program:

- Complete TACAWS integration studies, initiate LCPK integration concept and continue NLW for rotorcraft studies (689)
- Provide HQ criteria for cargo class rotorcraft slung load night operations; demonstrate carefree maneuvering using control limiting/cueing/applying neural nets; complete bench demonstration of full IFFC and initiate planning and preparation for future flight test demonstration; complete checkout of RASCAL research flight control system and initiate flight simulations (2981)
- Develop the critical aeromechanics tools to support dual-use and military applications of new and revolutionary rotors/controls concepts for low-cost, high technology rotor/fuselage systems (1317)
- Complete demonstration and evaluation of manufacturing process and tooling expert system and complete fabrication of damage tolerant hub flexures (2168)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602211A Aviation Technology

- Conduct engine test of low inertia turbine; component test Army/Air Force high pressure ratio centrifugal compressor; and initiate ceramic matrix composite turbine program (1207)
- Continue the development of an onboard weight and balance sensing system (706)
- Continue analytical and laboratory investigation of helicopter advanced sensor susceptibility reductions and directed energy weapon hardening; complete investigation of large rotorcraft crashworthiness and present recommended criteria to government/industry (2964)
- Determine operational worth of advanced manned and unmanned VTOL systems in military/civilian applications through simulation and analysis. (2564)
- Begin extensive formal workstation evaluation of MIDAS (3620)
- Establish a NRTC to harmonize civil and military design requirements and associated specifications and standards, and apply/refine use of IPPD approaches/principles to the development of technologies to reduce direct manufacturing and operating costs for the helicopter industry, and evolve critical technologies to enable exploitation of dual-use for rotary-wing applications (5078)

Project A47B - Vehicle Propulsion and Structures Technology: The purpose of this project is to conduct exploratory development of generic propulsion and structures technology in support of DoD/Army VTOL airmobile systems improvements. Areas of investigation and research include concepts of: small airflow gas turbines; high temperature materials; mechanical drive systems; integrated composites structural integrity; low cost manufacturing concepts; aerodynamic loads; aeroelastic interactions; and environmental control systems. The propulsion technology in this project supports the Army Aviation Research, Development and Engineering Center (RDEC) focus on the goals of the DoD Integrated High Performance Turbine Engine Technology (IHPTET) Program. The goal of IHPTET is to demonstrate technology which would double propulsion system capability for a wide range of potential future aircraft and missile applications.

FY 1994 Accomplishments:

- Evaluated compliant backed ceramic combustor liner concept with advanced fuel injectors for 3000 degrees F applications (541)
- Mapped Laser Doppler Velocimetry (LDV) flow test data for 5:1 2-stage axial compressor (520)
- Completed analytical testing of cooled radial turbine (338)
- Developed split torque drive train analytical method (400)
- Evaluated low noise spiral bevel gear design and evaluated enhanced face gear components (909)
- Evaluated fuel bladder crash protection concepts; validated analyses of large pre-twist on extension twist coupled composite blades; and modeled skin/stringer disbonding in composite panels (618)
- Fabricated updated parametric bearingless hub and baseline blade for loads and vibration research program using Advanced Research Experiment System (ARES II) control algorithms (647)
- Applied thermal diffusivity Non-Destructive Evaluation (NDE) methods to industry-provided panels with manufacturing defects; validated bending-torsion designs; and demonstrated capability of non-linear loom to fabricate net-shape woven preforms (696)

FY 1995 Planned Program:

- Develop and test carburized and ground face gears and demonstrate health/usage monitoring developed for the OH-58D transmission (486)
- Design and analyze Ceramic Matrix Composite (CMC) turbine nozzle (516)

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- Evaluate stability enhancement for turbine engines (482)
- Develop waverotor cycle design with combustion (495)
- Modify hardware and fuselage to eliminate interference problems with ARES II, evaluate control algorithms, and conduct wind tunnel tests in the Langley Transonic Dynamics Tunnel (TDT) (410)
- Publish results on skin/stringer disbonding of composite panels; incorporate advanced models for evaluating progressive failure in laminated composites; and develop finite element model for elastically coupled composite tilt-rotor blades (417)
- Develop prototype thermal NDE hardware for composites field inspection and manufacturing quality assurance; validate bending-torsion stiffness design technique; incorporate advanced fabrication concepts for net-shape woven preforms; and design optimized efficient energy absorbing fuselage frames (415)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (69)

FY 1996 Planned Program:

- Perform durability test of advanced fuel injector and compliant-backed ceramic combustor liner (404)
- Complete testing of splittered rotor (424)
- Couple waverotor with combustor to simulate engine cycle (398)
- Complete test rig demonstration of high temperature magnetic bearing (298)
- Test a smart-material active control technique in the TDT with neural network controllers (410)
- Test and evaluate advanced damage constitutive models for delamination failure and validate composites reliability-based fatigue methodology (299)
- Demonstrate advanced concepts for fabricating net-shape woven preforms;. evaluate prototype thermal NDE system on composite structures; and test near-field acoustical holography as a global measurement technique in actual aircraft-type structure (416)

FY 1997 Planned Program:

- Complete waverotor hot cycle experimental program with combustion and waverotor/gas turbine engine integration (525)
- Complete ceramic matrix composite turbine nozzle hardware fabrication for IHPTET application (325)
- Complete advanced compressor test program for Joint Turbine Advanced Gas Generator (JTAGG) II application (425)
- Complete full scale testing of face gear transmission (325)
- Conduct wind tunnel tests in the Langley Transonic Dynamics Tunnel to investigate air resonance and vibration characteristics of advanced rotor systems (412)
- Validate stress and strain failure analysis and incorporate with NDE methods to demonstrate a full integrated stress-strength-inspection methodology (404)
- Develop automated and non-contacting NDE methods for large area structural inspection and analytically model the response and failure of graphite-epoxy (GR-EP) composite frames for crashworthy aircraft design (335)

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	35107	19993	19223	19787
Appropriated Value	35107	19962		

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602211A Aviation Technology

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Adjustments to Appropriated Value	-537			
a. SBIR/STTR decrement (-217)				
b. Reprogramming total (-320)				
Current President's Budget Submit	34570	19962	20381	26045

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602211A Aviation Technology

PROJECT: AH85

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH85 Aircraft Avionics Technology	6897	0	0	0	0	0	0	0	0	6897

C. **Other Program Funding Summary**: See Paragraph A for related programs

D. **Schedule Profile**: The efforts funded in this project are non-system specific and represent continuing exploratory development research in the areas of avionics, command and control, and other platform electronics (continues in FY 95 and beyond in Project A779 as stated under paragraph A). Therefore, no milestones are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602211A Aviation Technology

PROJECT: A47A

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A47A Aeronautical and Aircraft Weapons Technology	23004	16672	17732	23294	25212	27636	27037	29658	Continuing	Continuing

C. **Other Program Funding Summary:** See Paragraph A for related programs

D. **Schedule Profile**: The efforts funded in this project are non-system specific and represent continuing exploratory development research in the areas of aeronautical design, aeromechanics, aerodynamics, aircraft weaponization, and rotorcraft sustainability, supportability, survivability, and maintainability. Therefore, no milestones are provided.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1995
BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602211A Aviation Technology		PROJECT: A47B

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A47B Vehicle Propulsion and Structures Technology	4669	3290	2649	2751	2888	3094	3098	3376	Continuing	Continuing

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**: The efforts funded in this project are non-system specific and represent continuing exploratory development research in the areas of generic propulsion and structures technology in support of DoD/Army VTOL airmobile systems. Therefore, no milestones are provided for these on-going efforts.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602270A EW Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	20656	18122	15311	14970	15389	16193	17351	17798	Continuing	Continuing
A442 Tactical Electronic Warfare Technology	10971	10023	9274	8887	9197	9648	10305	10570	Continuing	Continuing
A906 Tactical Electronic Warfare Techniques	9685	8099	6037	6083	6192	6545	7046	7228	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program provides for exploratory development of electronic warfare (EW) technologies for current and future systems. The efforts in EW will enable the Army to deny the enemy use of the radio spectrum for command, control, communications and computer intelligence purposes, and provide a decisive advantage to our operational forces against the full range of traditional and non-traditional threat forces. It also involves development of automated intelligence fusion systems and techniques for managing assets on the battlefield. Work in this program will lead to winning the battlefield information war by controlling the electromagnetic spectrum and conducting successful electronic disruptive/destructive operations inside of the enemy decision cycle. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), Science and Technology Objectives (STOs) and the Army Modernization Plan and adheres to Tri-Service Reliance Agreements on electronic warfare with oversight provided by the Joint Directors of Laboratories. This program includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2. It is related to and fully coordinated with efforts in PE #0602782A (Command, Control & Communications (C3) Technology), PE #0603789F (C3 Intelligence (I) Technology Development), PE #0603270A (Electronic Warfare Technology), PE #0604270A (Electronic Warfare Development), and PE #0603745A (Tactical Electronic Support Systems - Advanced Development) in accordance with the ongoing Reliance joint planning process. This program is primarily managed by Communications-Electronics Research, Development and Engineering Center (CERDEC), Fort Monmouth, NJ.

Project A442 - Tactical Electronic Warfare Technology: This project develops electronic warfare sensor and countermeasure (CM) technologies for self protection of air and ground platforms, area protection against radar directed weapons (i.e., jamming of enemy counter mortar/counter battery radars), and combat surveillance and target acquisition. The following technology areas are investigated:

- Infrared (IR) countermeasures (IRCM) - technologies that provide air and ground platforms with the capability to detect and jam heat-seeking surface-to-air missiles and anti-tank guided missiles with active IR sources, or to decoy them with flares or other devices.
- Self-protection radar countermeasures/warning - technologies that provide air and ground platforms with warning and jamming against radar directed air defense weapons, and jamming of top attack/smart munitions/ artillery delivered radio proximity fuzes.
- Laser warning and countermeasures - technologies that provide air and ground platforms with warning and jamming capability against laser-aided and optically-directed threats including laser range finders, laser designators and laser beamrider missiles.
- Electronic Support (ES) - technologies that provide the capability to intercept, direction find, and locate current and emerging hostile non-communications emitters for targeting and tactical situational awareness.
- Area protection radar countermeasures - technologies that provide radar stand-off and stand-in jamming and deception in support of ground forces.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602270A EW Technology

FY 1994 Accomplishments:

- Conducted test on monopulse countermeasures against foreign air defense system; received delivery of monopulse electronic countermeasures (ECM) test bed and conducted ECM testing against advanced foreign monopulse air-to-air missiles (3575)
- Demonstrated lightweight beam steering hardware with visible laser; upgraded laser diode jammer to three diode configuration (continuous wave and modulated threats) vs. anti-tank guided missiles (ATGMs); completed evaluation of automatic tracking subsystem (ATS) for use in IRCM systems (4596)
- Conducted multi-service multipath test of surface acoustic wave (SAW) channelized compressive interferometer (SCCI), manpack and Canadian ES systems at Fort Huachuca, AZ (805)
- Completed next generation ES processor study for potential improvements in emitter identification, deinterleaving techniques, direction finding (DF)/geolocation algorithms and multipath rejection (605)
- Integrated ceramic phase shifters into phased array antenna to improve DF accuracy in ES/electronic intelligence (ELINT) systems (800)
- Reduced size, weight and cost of waveform generation/transmitter subsystems of the WARLOCK for testing and demonstration of the ability to generate false targets (300)
- Performed a lab demonstration of a moving platform capability of WARLOCK X by making software module upgrades to existing hardware (290)

FY 1995 Planned Program:

- Demonstrate jamming techniques against single and multi-spectral top attack smart munitions; conduct field test of high accuracy DF antennas for aircraft and ground vehicle warning receivers; and initiate development of electronic attack (EA) modulation test bed vs. ultra high frequency (UHF) through millimeter wave sensors and radars (3535)
- Demonstrate beam coupler for Advanced Research Projects Agency (ARPA) laser/anti-tank IRCM point/track; implement head missile warning and beam steering technology and advanced jamming techniques for multi-spectral technology demonstration; evaluate IRCM techniques for top attack threats to ground vehicles (4081)
- Design an omni-directional, high gain, multiband antenna which provides the technology to replace current spinning dish antennas for the intelligence electronic warfare common sensor (IEWCS) (930)
- Initiate the design of an ES/super high frequency (SHF) receiver to complement the omni-directional antenna in order to increase the ability of the IEWCS to exploit modern radar signals (800)
- Implement programs for advanced countermeasures against imaging radar systems (200)
- Continue WARLOCK X program and field test (219)
- Implement program to target non-conventional sensors for deception and non-communication jamming purposes (258)

FY 1996 Planned Program:

- Demonstrate radio frequency (RF) sensor and EA modulator with capability to locate, deceive and jam monopulse and phased array radars from UHF through millimeter wave; demonstrate use of fiber optics to remote sensors and jamming modules from UHF through millimeter wave; initiate development of low cost finger-printing for signal sorting and combat identification (ID) assistance (3120)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602270A EW Technology

- Demonstrate missile warning sensor for low observable (LO) platforms; develop gimbal-less beam steering; develop CM to advanced electro-optic-infrared (EOIR) missiles using imaging seekers (3877)
- Complete the design of the ES/SHF receiver and demonstrate the advantages over current antennas (580)
- Initiate the design of an ES signal processor to provide optimal exploitation of radar signals of interest (535)
- Initiate fabrication of the omni-directional, high gain, multi-band antenna (632)
- Continue program for advanced countermeasures against imaging radar systems (250)
- Continue efforts to target non-conventional sensors to develop "surgical" countermeasures techniques (280)

FY 1997 Planned Program:

- Continue development of low cost finger-printing signal sorting, jamming and combat ID assistance; initiate EA testing against bistatic, impulse and low probability of intercept radars; initiate RF countermeasures vs. advanced multi-function munitions/weapons that attack both air and ground vehicles (3112)
- Exploit advanced EOIR CM against advanced threat missiles (surface-to-air missiles (SAMs) and anti-tank missiles); transition techniques to multi-spectral technology demonstration (PE 0603270A, project DK16) (3530)
- Complete the design of the ES signal processor and demonstrate its performance improvements over currently used processors (730)
- Demonstrate the omni-directional, high-gain, multiband antenna with the next generation ES/SHF receiver (598)
- Implement initiative to develop countermeasures to exploit digital radars (250)
- Continue program for advanced countermeasures against imaging radar systems (280)
- Continue efforts to target non-conventional sensors to develop "surgical" countermeasures techniques (387)

Project A906 - Tactical Electronic Warfare Techniques: This exploratory development program involves technologies that provide the capability to intercept, DF and locate current and emerging threat communications emitters for targeting, tactical situation awareness, and disruption/destruction of enemy command, control and communications (C3) systems. It specifically develops essential electronic attack (EA) components and techniques for advanced jammers and smaller, low power, lightweight, common modules for advanced systems to counter communications associated with modern threat C3 systems. This effort guarantees friendly force ownership of the electromagnetic spectrum. This program also involves fusion (automated assimilation and synthesis) of battlefield intelligence data. It specifically involves development and demonstration of fusion technology to automate manpower intensive command and control information from battlefield sensors, enabling friendly commanders to operate inside of the enemy decision cycle. Resultant enhancements will support joint C3 warfare, by denying threat forces access to their own C3 systems and operating within the decision cycle of threat C3 systems that survive.

FY 1994 Accomplishments:

- Fabricated and tested high frequency (HF) antenna with high temperature superconductive (HTSC) coil for size, weight and power reduction of groundbased intelligence electronic warfare (IEW) antenna applications (1180)
- Developed a phase tracking subsystem that separates signals on the same frequency by power separation for single channel ground/air radio system (SINCGARS) (1000)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602270A EW Technology

- Designed quadratic residue number system logic layout and board design for the development of an efficient wideband receiver utilizing fast Fourier Transform (FFT) application specific integrated circuit (ASIC) for reduced weight/power and lower cost applications for IEWCS, unmanned aerial vehicles (UAVs) and manpack systems (1500)
- Constructed and tested 300 Watt adaptive jammer power amplifier which adapts system output power, frequency range, modulation type, signal purity and agility according to mission requirements (1417)
- Examined vulnerability of mobile cellular radio systems for purpose of developing exploitation strategies. Transitioned results from signal type 1 to PE 0603270A/DK15 for demonstration purposes (1420)
- Completed spatial/map reasoning algorithms for development of automated intelligence overlays and terrain features (1468)
- Initiated development of correlation and templating, automated tracking, cross-queuing and situation display tools and techniques (1100)
- Acquired, analyzed and exploited modern tactical communications systems to develop EA strategies and update IEWCS threat system database (600)

FY 1995 Planned Program:

- Fabricate high frequency (HF) antenna technology demonstrator and transformer utilizing HTSC materials and test functionality (1132)
- Analyze diverse antenna applications against platform requirements for optimization purposes (800)
- Examine vulnerability of mobile cellular radio systems with type 2 and type 3 signals for purpose of developing exploitation strategies (1500)
- Acquire, analyze and exploit modern tactical communications systems to develop EA strategies and update IEWCS threat system database (300)
- Fabricate and test ASIC utilizing quadratic residue number system (QRNS) logic results for efficient wideband receiver developments (1400)
- Continue development of correlation and templating, automated tracking, cross-queuing and situation display tools and techniques (800)
- Initiate battlefield visualization techniques for enemy and friendly situation visualization, enhanced targeting and situation assessment/development (400)
- Complete signal intelligence (SIGINT) asset effectiveness and planning tools (600)
- Complete terrain/map reasoning for automated overlays and terrain features and battlefield damage assessment techniques and tools. Transition to PE 0603270A/DK15 for demonstration (500)
- Initiate efforts to provide tools and techniques to effectively task and receive reports from modern multi-intelligence sensor platforms (500)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (167)

FY 1996 Planned Program:

- Continue fabrication of HF antenna technology demonstrator and transformer utilizing HTSC materials and test functionality (800)
- Continue analysis of diverse antenna applications against platform requirements for optimization purposes prior to design of optimal antenna for demonstration in PE 0603270A/DK15 (800)
- Complete vulnerability assessment of mobile cellular radio systems with type 2 and type 3 signals. Transition results to PE 0603270A/DK15 for demonstration (900)
- Acquire, analyze and exploit modern tactical communications systems to develop EA strategies and update IEWCS threat system database (300)
- Complete development of the efficient wideband receiver with the final breadboard configuration of the fast Fourier Transform (FFT) ASIC utilizing QRNS. Transition to PE 0603270A/DK15 for integra ion and demonstration (1500)

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- Continue development of correlation and templating, automated tracking, cross-queuing and situation display tools and techniques (600)
- Continue battlefield visualization techniques for enemy and friendly situation visualization, enhanced targeting and situation assessment/development for tactical IEW applications (800)
- Continue efforts to provide tools and techniques to effectively task and receive reports from modern multi-intelligence sensor platforms (337)

FY 1997 Planned Program:

- Complete testing of HF antenna technology demonstrator and transformer prior to demonstration in PE 0603270A/DK15 (1600)
- Acquire, analyze and exploit modern tactical communications systems to develop EA strategies and update IEWCS threat system database (600)
- Continue IEW battlefield visualization techniques for enemy and friendly situation visualization, enhanced targeting and situation assessment/development (900)
- Initiate examination of personal communication networks for development of exploitation techniques (1200)
- Complete development of correlation and templating, automated tracking, cross-queuing and situation display tools and techniques and transition to PE 0603270A/DK15 for demonstration and field testing (1100)
- Continue efforts to provide tools and techniques to effectively task and receive reports from modern multi-intelligence sensor platforms (683)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	20921	18256	15133	14748
Appropriated Value	20921	18122		
Adjustments to Appropriated Value	-265			
a. SBIR/STTR decrement (-143)				
b. Reprogramming (-122)				
Current President's Budget Submit	20656	18122	15311	14970

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DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602270A EW Technology

PROJECT: A442

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A442 Tactical Electronic Warfare Technology	10971	10023	9274	8887	9197	9648	10305	10570	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Electronic Warfare Technology; therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602270A EW Technology

PROJECT: A906

COST (In Thousands)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A906 Tactical Electronic Warfare Techniques	9685	8099	6037	6083	6192	6545	7046	7228	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Electronic Warfare Techniques; therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602303A Missile Technology

PROJECT: A214

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A214 Missile Technology	22674	23520	17985	22607	24375	26045	24269	24895	Continuing	Continuing

A. **Mission Description and Budget Item Justification**: This exploratory development program is designed to provide the Army with missile and rocket technologies, potential system upgrades and next generation weapon systems. Its overall objective is to provide a continental U.S. (CONUS)-based, post-cold-war Army with weapon systems enabling immediate world-wide deployment of forces with the capability to initially contain and ultimately achieve decisive victory against hostile forces equipped with modern weapons. The program is driven by U. S. Army Training and Doctrine Command (TRADOC) battlefield dynamics Battle Labs and mission area analyses of deficiencies in the areas of close combat, fire support, air defense, intelligence/electronic warfare, and the Army Science and Technology Master Plan. The program is focused on technologies which enhance weapon system deployability, flexibility, lethality, survivability, and affordability. Work within the program is conducted through system simulation, virtual prototyping, concept synthesis, hardware development, and focused technology demonstrations. The work in this program element is consistent with the resource constrained Army Science and Technology Master Plan, the Army Modernization Plan and Project Reliance. 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 Independent Research Center), PE 0603313A (Missile and Rocket Advanced Technology), PE 0603654A (LOSAT Technology Demonstration) and PE 0602782A (Command Control and Communication (C^3)Technology) in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments. This project includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL.

Project A214 - Missile Technology: Efforts in this project are focused on missile and rocket technologies that support high lethality, high fire power, and reduced weight concepts for the early entry forces, address system concepts that enhance the survivability of launch systems, provide greater effectiveness under adverse battlefield conditions, increase kill probabilities against hard targets, and provide powerful new simulation and virtual prototyping analysis tools. This project encompasses seven major areas: missile guidance systems; air defense target acquisition systems; multi-spectral missile seekers; high fidelity system level simulations; missile aerodynamics and structures; smart, minimum signature missile propulsion; and focused technology integration demonstrations. As efforts in these technology areas mature, work is transitioned to PE 0603313A (Missile & Rocket Advanced Technology) to support demonstrations of capabilities for early entry forces in the Rapid Force Projection Initiative (RFPI), The Army Combined Arms Weapon System (TACAWS), and an advanced light weight hypervelocity missile.

FY 1994 Accomplishments:

- Missile guidance systems - Developed first generation low cost, high g inertial components; demonstrated miniature single-axis fiber optic laser gyro; developed real-time executive software in Ada; demonstrated hypervelocity control actuation system; Designed preliminary guidance package for deployable wing; field tested scatterider test sensor and validated the concept (4210)
- Air defense acquisition systems - Integrated acoustic, Forward Looking Infrared (FLIR), television, and passive radio frequency sensors for air defense platform; developed software for a multi-sensor suite; demonstrated a bistatic laser radar (LADAR); developed radar target detection algorithms (2050)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602303A Missile Technology

- Multi-spectral missile seekers - Demonstrated an Identification Friend or Foe algorithm compatible imaging infrared seeker; conducted laboratory tests of uncooled imaging infrared seeker; designed Millimeter Wave (MMW) rapid cueing sensor; designed prototype processor for imaging autotracker (2205)
- High fidelity system level simulations - Developed an image editing routine to reduce spectral leakage from windowing; produced targets for Patriot Advanced Capability Block 3 (PAC-3) and Longbow hardware-in-the-loop simulations; produced chaff model for electronic countermeasure studies; performed preliminary analysis of infra-red scene projector (1690)
- Missile aerodynamics and structure - Demonstrated a lightweight composite blast shield; completed multi-body flexible models of Line-of-Sight Antitank (LOSAT) system; completed computational fluid dynamics (CFD) models for Ducted Rocket Engine (DRE) (3040)
- Smart, stealthy, smokeless missile propulsion - Tested non-carcinogenic, minimum signature fuel gel in bi-gel motor; evaluated 50% fullerene fuel; conducted gel firing tests to establish bi-gel engine capabilities; designed, fabricated, and tested air turbo ramjet for boost and sustain requirements; evaluated boost/sustain turbojet propulsion system for Long Range Fiber Optic Guided missile (LONGFOG) (3110)
- Focused technology integration/demonstrations - Completed simulation and began system trade study for adaptive missile demonstration; simulated and conducted inertially guided advanced hypervelocity missile flights; integrated improved optics and electro-optic devices into brassboard optical correlator for automatic target recognition simulation; designed the DRE hardware (6369)

FY 1995 Planned Program:

- Missile guidance systems - Demonstrate low cost, accurate guidance and control (G&C); transition G&C technology (e.g., The Army Combined Arms Weapon System (TACAWS) and Enhanced Fiber Optic Guided Missile (EFOG-M)); develop and flight test guidance systems deployable wings (3755)
- Air defense target acquisition systems - Test integrated air defense missile target acquisition/fire control system using operational requirements germaine to TACAWS and EFOG-M (1865)
- Multi-spectral missile seekers - Analyze seeker performance in tower and captive carry flight tests using TACAWS operational criteria (1655)
- High fidelity system level simulations - Optimize scene generation techniques for next generation tactical missile simulations; transition technology into system simulations for operational and developing systems such as Patriot and Javelin, follow on to Tube Launched Optically Tracked Wire guided (TOW) missile, Advanced Stinger, Brilliant Antitank (BAT) (1250)
- Missile aerodynamics and structure - Validate aero/structural models and develop visualization techniques applicable to tactical missile design; bench test candidate advanced materials and transition to upgrades of fielded systems and new missile concepts such as TACAWS (2800)
- Smart, stealthy, smokeless missile propulsion - Demonstrate smart adaptable propulsion; demonstrate small turbo rocket; demonstrate environmentally benign propulsion and radar absorbing materials for specific civilian and military applications; develop vortex injector bi-gel engine (3450)
- Focused technology integration/demonstrations - Complete system trade study, conduct preliminary design, and conduct captive carry seeker tests for the adaptive missile demonstration; analyze advanced hypervelocity missile flight test results and perform second flight test; demonstrate heavywall ducted rocket for Japan Cooperative Program; demonstrate robust auto target recognition with prototype optical correlator; fabricate subsystems for LONGFOG (8745)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602303A Missile Technology
	PROJECT A214

FY 1996 Planned Program:

- Missile guidance systems - Develop low cost, low weight/volume G&C package for insertion into DoD missile systems; develop alternative guidance techniques; develop missile and fire control software for next generation G&C subsystems (2050)
- Air defense target acquisition systems - Develop air defense fire control target acquisition algorithms and multi-sensor suites; develop active/passive target recognition algorithms (1135)
- Multi-spectral missile seekers - Develop missile seeker wide field-of-regard search and hand off techniques compatible with autonomous target acquisition;
- test seeker hardware (1100)
- High fidelity system level simulations - Develop and demonstrate improved techniques for target signature for hardware-in-the-loop simulation; apply commercial
- technology to simulation processors and scene generators for low cost solutions (600)
- Missile aerodynamics and structure - Validate rotary wing aero-propulsion model; evaluate and select advanced materials for structural modeling development; develop warhead guidance fusing techniques to increase capabilities of air defense systems; validate current air target penetration equations for Countering Armor Protection Systems (CAPS) problems (2155)
- Smart, stealthy, smokeless missile propulsion - Continue development of smart propulsion componentry technology for application to adaptable, multimission, light weight, survivable systems (1996)
- Focused technology integration/demonstrations - Integrate LONGFOG components into airframe guided flight test; convert and demonstrate optical correlator for use in the infrared (IR) spectrum; continue ducted rocket demonstration for Japan Cooperative Program (8949)

FY 1997 Planned Program:

- Missile guidance systems - Demonstrate low cost, low weight/volume guidance and control package for insertion into DoD missile systems; demonstrate software for advanced operating system and develop software reuse approaches (3920)
- Air defense target acquisition systems - Demonstrate advanced air defense fire control target acquisition algorithms and multi-sensor suites; test active/passive target recognition algorithms in operational scenarios; evaluate automatic target recognition algorithms for adaptive missile (1771)
- Multi-spectral missile seekers - Demonstrate missile seeker search and hand-off techniques applicable to autonomous target acquisition (1725)
- High fidelity system level simulations - Develop improved radio frequency signal modulators; upgrade target signature and scene generator control software to accommodate improved generation techniques; evaluate infrared scene projectors (1650)
- Missile aerodynamics and structure - Implement modeling codes for aerodynamic, structural, warhead fusing, and missile concept evaluation; complete integration of
- CAPS long standoff warheads into missile testbed and test; test advanced composites (1812)
- Smart, stealthy, smokeless missile propulsion - Demonstrate and test advanced propulsion concepts such as ducted rocket engines, air turbo rockets, advanced solid propulsion, gel motors, and hybrid concepts (2933)
- Focused technology integration/demonstrations - Demonstrate component technologies that show feasibility of developing a long range, high and low speed, smart, adaptable missile; complete LONGFOG flight demonstration; complete ducted rocket demonstration for Japan Cooperative Program (8796).

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602303A Missile Technology / PROJECT: A214

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	23255	23301	21848	22410
Appropriated Value	23255	23520		
Adjustments to Appropriated Value	-581			
Reprogramming (-581)				
Current President's Budget Submit	22674	23520	17985	22607

C. Other Program Funding Summary: See paragraph A for related programs.

D. Schedule Profile: The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Missile Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602307A Advanced Weapons Technology

PROJECT: A139

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A139 Directed Energy Technology	4000	3945	0	0	0	0	0	0	0	7945

A. Mission Description and Budget Item Justification: Funds for this program were added by Congress. This program element provides for the development of those specialized technologies associated with advanced, directed energy weapons. It includes high energy lasers and other types of radiative weapons employing both narrow and wide band Radio Frequency (RF) energy, and also focuses on high bandwidth data links using optical fiber and microwave technology for advanced missiles carrying multispectrum imaging and non-imaging sensors. The program terminates after FY 95. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), Science and Technology Objectives (STOs), and the Army Modernization Plan. This program adheres to the Tri-Service Reliance Agreements on Conventional Air/Surface Weaponry and Directed Energy Weaponry with oversight provided by the Joint Directors of Laboratories. Work in this Program Element is related to and fully coordinated with efforts in PE 0605601A (Army Test Ranges and Facilities), PE 0602601F, PE 0603221C, PE 0602301E, and PE 0602707E in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments. The Army is no longer pursuing high energy laser technology. Low power laser technology for military applications is funded in PE 602709A. This project includes non-system specific development efforts pointed toward specific military needs and is therefore appropriately placed in Budget Activity 2.

Project A139 - Directed Energy Technology: This project will develop technologies related to the use of directed energy as a weapon against hardened targets based on the fact that optical and Radio Frequency components are inherently vulnerable to laser radiation in their operating bands. Solid state dye lasers provide wavelength agile sources for a variety of military anti-sensor applications as well as the wavelength diversity necessary for medical applications. Technology will be developed for this dual use application. Limited funding requires close coordination with the other services and agencies through the Joint Directors of Laboratories (JDL) Reliance Panel on Directed Energy Weaponry. Work is primarily performed by U.S. Army Missile Command (MICOM), Research, Development, and Engineering Center, Redstone Arsenal, AL.

FY 1994 Accomplishments:

- Initiated efforts to demonstrate solid state dye lasers, developed new laser dyes, developed improved laser materials, improved laser beam quality, and developed diode arrays for medical applications (3905)
- Solicited, evaluated, and began negotiations with successful offerors to a MICOM Broad Agency Announcement (BAA) (85)
- Participated in the Joint Directors of Laboratories (JDL) Reliance Panel on Directed Energy Weaponry; published Laser Devices report (10)

FY 1995 Planned Program:

- Demonstrate improved performance of solid state dye lasers for military and medical applications (3557)
- Develop new laser dyes with increased service life and greater efficiency (175)
- Develop improved Sol-Gel materials as alternate hosts for solid state dye lasers (80)
- Investigate laser beam quality improvements (50)

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602307A Advanced Weapons Technology — PROJECT: A139

- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (83)

FY 1996 Planned Program: Program not funded

FY 1997 Planned Program: Program not funded

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	4509	0	0	0
Appropriated Value	4509	3945		
Adjustments to Appropriated Value	-509			
Reprogramming (-509)				
Current President's Budget Submit	4000	3945	0	0

C. Other Program Funding Summary: See paragraph A for related programs.

D. Schedule Profile: The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Missile Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602308A Modeling And Simulation

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	9845	58230	23770	30764	35357	35830	36117	37456	Continuing	Continuing
AC88 Plowshares	0	4933	0	0	0	0	0	0	0	4933
AC90 Distributed Interactive Simulation (DIS) Technology	0	13397	11323	10800	10463	10810	10820	11100	Continuing	Continuing
AC99 Modeling and Simulation Technology	9845	39900	12447	19964	24894	25020	25297	26356	Continuing	Continuing

A. **Mission Description and Budget Item Justification:** Work in this program element (PE) advances the development and use of modeling and simulation, including Distributed Interactive Simulation (DIS), as related to Army-specific experiments/demonstrations and industry participation at the U. S. Army Training and Doctrine Command (TRADOC) Battle Labs and Army's Louisiana Maneuvers (LAM). It develops standards, architecture and interfaces that are essential to realizing the DoD/Army vision of creating a verified, validated and accredited synthetic "electronic battlefield" environment. The electronic battlefield is used to investigate and demonstrate new warfighting concepts and approaches including development of tactics, doctrine, training techniques, soldier support, systems and system upgrades. It directs and stimulates advances in those technologies required for real time interactive linking within and among constructive, virtual and live simulations. Work also supports planning and execution of the Advanced Concepts and Technology (ACT) II program, which evaluates new concepts. ACT II focuses on providing a timely, low overhead mechanism for industry and academia to participate in the Army's Louisiana Maneuvers and TRADOC Battle Labs warfighting demonstrations and experiments. The work in this program element is consistent with the Army Science and Technology Master Plan and the Army Modernization Plan. Efforts in this Program Element include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Work is performed by the broadest range of the nation's industrial and academic communities. Contractors include: Loral Western Development Laboratories, San Jose, CA; Pathfinder, Littleton, CO; University of Central Florida, Institute for Simulation and Training, Orlando, FL; Georgia Tech Research Institute, Atlanta, GA; Veda Incorporated, Orlando, FL; University of Alabama, Tuscaloosa, AL; Perceptronics, Inc., Woodland Hills, CA; Lockheed Sanders, Nashua, NH; Martin Marietta, Daytona Beach, FL; Evans & Sutherland, Salt Lake City, UT. Simulation, Training and Instrumentation Command (STRICOM), Orlando, FL. is responsible for Project AC90 and Army Research Office, Raleigh, NC is responsible for Project AC99. Efforts for ACT II are being performed by the following contractors: GTE, Motorola, ITT Aerospace, Hughes Aircraft Research Labs, Haseltine, Telephonics, Mystech, Rockwell International, Litton Data Systems, Grumman Aerospace, Lockheed Sanders, Vector Research, SAIC, Loral Vought Systems, United Technologies/Sikorsky, Northrop, E-Systems Melpar, Spectro Dynamic Systems, United Technologies, Draper Laboratory, Boeing, AAI, Optimetrics, Bevilacqua.

Future efforts will be performed by a broad range of contractors selected in response to the Broad Agency Announcement (BAA) process. This program is fully coordinated with the other Army exploratory development programs, Advanced Research Projects Agency (ARPA), Defense Modeling and Simulation Office, TRADOC and DoD Project Reliance agreements on conventional air/surface weaponry with oversight provided by the Joint Directors of Laboratories. Work in this Program Element is related to and fully coordinated with efforts PE #0604715A (Non-System Training Devices - Engineering Development). There is no unnecessary duplication of effort within the Army or Department of Defense.

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602308A Modeling And Simulation

Project AC88 - Plowshares: Plowshares is a technology initiative to transition DoD simulation to civil application (e.g., support Civil Disaster/Emergency Preparedness training). Knowledge gained specifically applicable to the coordination of Military and Civilian Emergency Management Authorities will be facilitated through Plowshares. Plowshares will explore Distributed Interactive Simulation technology and its potential to support emergency management training-type systems for possible distribution among federal, state, and local governments. Plowshares has potential to use the Defense Simulation Internet (DSI). Ultimately, Plowshares could support simulated coordinated training at local jurisdictions, multi-local jurisdictions, local jurisdictions with state; multi-states; and state(s) with national agency(ies) with the focus on management direction and control of limited emergency resources.

FY 1994 Accomplishments: Project established FY95.

FY 1995 Planned Program:

- Define requirement and demonstrate linkage of multi-jurisdictions and states with national agencies in DIS environments (2281)
- Expand the modeling and simulation (M&S) task database to include emergency management response requirements for local, state and national mission training plans in support of scenario generation and measures of effectiveness (363)
- Modify databases and application software to simulate additional disasters (flood, fire, terrorist attacks, civil unrest, nuclear, etc.) (983)
- Explore the use of semi-automated forces to support coordinated efforts during joint exercise (358)
- Explore feasibility to support civil defense/disaster training to foreign governments in support of Under Secretary of Defense for Policy Support (USD(P)) activities with North Atlantic Treaty Organization (NATO) (483)
- Research terrain and scenario event requirements for Army participation in joint exercise simulations (361)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (104)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project AC90 - Distributed Interactive Simulations (DIS) Technology: This program provides and demonstrates enabling technologies for advancing Distributed Interactive Simulation (DIS) networking capabilities and synthetic representation of the battlefield needed to support virtual prototyping and training in the era of reduced funding. Efforts in this project support the Battlefield Distributed Simulation-Developmental (BDS-D) program. BDS-D will provide virtual representation of a lethal combined arms environment with the warfighter-in-the-loop that closed-form analysis cannot provide. The environment permits new system concepts, tactics and doctrine and test requirements to be evaluated with a warfighter-in-the-loop in a combined arms battlefield throughout the acquisition life cycle at a reduced cost and time than the traditional approach. The research being conducted includes Semi-Automated Forces (SAFOR), dynamic terrain and data base development for networking. Arrival of this sophisticated technology, equipment and complex interactions with each other, makes this effort critical to the overall success of Army acquisition and training requirements.

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602308A Modeling And Simulation

FY 1994 Accomplishments: Project established FY95. Related work previously performed in PE 0602727A, Project A230, Non-Systems Training Devices and PE 0603003A, Project DB39, Advanced Distributed Simulation.

FY 1995 Planned Program:

- Define requirements and conduct experiments to demonstrate linkage of constructive (analytical and training wargame models) and virtual (simulators and computer generated forces) simulations in DIS environments (1098)
- Define the virtual reality interface and architecture requirements to network the dismounted infantry into the DIS environment (1721)
- Expand the architecture to accommodate increased Battlefield Operating System (BOS) functionality and capability supporting division level DIS experiments and mission rehearsals to include command, control and communications and countermeasure DIS environments (3839)
- Enhance standard for terrain databases to assure correlation and interpretability among simulators, semi-automated forces, and constructive simulations (1534)
- Develop soldier station prototypes linking to Janus and BDS-D simulators employing DIS protocols (500)
- Demonstrate dynamic terrain capability for DIS and investigate architectural changes to integrate into the DIS (1418)
- Continue development of standards for interfacing of Command, Control, Communications and Intelligence and Electronic Warfare (C3IEW) and initial (real) tactical communication systems and simulations to distributed combat/wargame simulations for digitizing the battlefield (506)
- Establish and develop Internet capabilities of the Federated Laboratory initiative of the Army Research Laboratory (ARL) (1000)
- Upgrade hardware, software, and interfaces for the Land Warrior Test Bed to facilitate infantry systems participation in virtual prototyping, advanced concepts, advanced technology demonstrations and DIS exercises (1500)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (281)

FY 1996 Planned Program:

- Continue development of standards for interfacing of C3IEW systems and C3IEW simulations to distributed combat/wargame simulations for digitizing the battlefield (500)
- Conduct experiments to provide DIS support of fielding of digitized division level force (200)
- Define the method and computational approach for full level force representation with the capability to be reconfigurable to varying battlefield behaviors (3540)
- Continue expansion of the architecture to support division level DIS experiments and mission rehearsals (7083)

FY 1997 Planned Program:

- Continue development of standards for interfacing of C3IEW systems and C3IEW simulations to distributed combat/wargame simulations for digitizing the battlefield (476)
- Demonstrate intelligent semi-automated force simulation technologies for division level forces (2283)
- Complete expansion of DIS architecture to support division level DIS experiments and mission rehearsals (6138)
- Complete enhancement of terrain databases (476)
- Provide DIS support of fielding/initial operations for digitized division level force and prepare to support corps level (1427)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602308A Modeling And Simulation

Project AC99 - Modeling and Simulation Technology: This project supports the Advanced Concepts and Technology (ACT) II Program. ACT II provides a timely, low-overhead mechanism, with a yearly Broad Agency Announcement (BAA) for industry and academia, to demonstrate mature technologies, prototypes, software and/or systems for assessment by the TRADOC Battle Labs and Louisiana Maneuvers Task Force. It supports new concepts evaluation through modeling and simulation in real time, soldier-in-the-loop, virtual and constructive, electronic battlefield demonstrations and field tests. Specific areas of interest include: battlespace management and battlefield synchronization; depth and simultaneous attack capabilities; early entry operations, lethality, survivability and mobility; command, control, communications and computers (to include interoperability); force sustainment; and doctrine and leader development.

FY 1994 Accomplishments:
- ACT II program initiated in FY 94
- Awarded 28 contracts as a result of more than 300 proposals submitted in response to a BAA (9845)

FY 1995 Planned Program:
- Conduct demonstrations and experiments in support of the Battle Labs and LAM (39062)
  This effort includes the following activities:
- Release BAA to solicit Battle Lab and LAM related concepts and technologies from the nation's industrial and academic communities
- Initiate two step proposal; two page pre-proposal followed by invitation for full proposals
- Select, within resource constraints, high payoff and innovative efforts for demonstration of new warfighting capabilities
- Analyze and evaluate the results of FY 1994 efforts; identify candidates for streamlined acquisitions
- Establish an order of merit list to provide continued funding to the most promising FY 1994 efforts
- Approve BAA topics for new ACT II projects to satisfy future Army and DoD needs not being addressed by existing programs
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (838)

FY 1996 Planned Program:
- Conduct demonstrations and experiments in support of the Battle Labs and LAM (12447)
  This effort includes the following activities:
- Release BAA to solicit Battle Lab and LAM related concepts and technologies from the nation's industrial and academic communities
- Select, within resource constraints, high payoff and innovative efforts for demonstration of new warfighting capabilities
- Analyze and evaluate the results of FY 1995 efforts; identify candidates for streamlined acquisitions
- Approve BAA topics for new ACT II projects to satisfy future Army and DoD needs not being addressed by existing programs

FY 1997 Planned Program:
- Conduct demonstrations and experiments in support of the Battle Labs and LAM (19964)
  This effort includes the following activities:

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602308A Modeling And Simulation

- Release BAA to solicit Battle Lab and LAM related concepts and technologies from the nation's industrial and academic communities
- Select, within resource constraints, high payoff and innovative efforts for demonstration of new warfighting capabilities
- Analyze and evaluate the results of FY 1996 efforts; identify candidates for streamlined acquisitions
- Approve BAA topics for new ACT II projects to satisfy future Army and DoD needs not being addressed by existing programs

B. Program Change Summary: See Paragraph A for related programs

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	10000	51517	41301	50917
Appropriated Value	10000	58230		
Adjustments to Appropriated Value	-155			
a. SBIR/STTR decrements (-155)				
b. Reprogramming total (0)				
Current President's Budget Submit	9845	58230	23770	30764

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602308A Modeling And Simulation		PROJECT AC88

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AC88 Plowshares	0	4933	0	0	0	0	0	0	0	4933

C. **Other Program Funding Summary:** See Paragraph A for related programs

D. **Schedule Profile:** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the areas of modeling and simulation including Distributed Interactive Simulation. Therefore, no milestones are provided.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1995
BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602308A Modeling And Simulation		PROJECT: AC90

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AC90 Distributed Interactive Simulation (DIS) Technology	0	13397	11323	10800	10463	10810	10820	11100	Continuing	Continuing

C. Other Program Funding Summary: See Paragraph A for related programs

D. Schedule Profile: The efforts funded in this project are non-system specific and represent continuing exploratory development research in the areas of modeling and simulation including Distributed Interactive Simulation. Therefore, no milestones are provided.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602308A Modeling And Simulation		PROJECT AC99

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AC99 Modeling and Simulation Technology	9845	39900	12447	19964	24894	25020	25297	26356	Continuing	Continuing

C. **Other Program Funding Summary:** See Paragraph A for related programs

D. **Schedule Profile:** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the areas of modeling and simulation and new concepts evaluation including field tests and Distributed Interactive Simulation. Therefore, no milestones are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602601A Cmbt Veh And Automotive Tech

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	37933	33506	39207	38288	39047	39537	38738	40573	Continuing	Continuing
DC05 Armor Exploratory Development	6882	6898	4002	6481	6468	7048	7454	7646	Continuing	Continuing
DC83 Tractor Card	0	0	2094	0	0	0	0	0	0	2094
AH74 Simulation Laboratory	0	5919	0	0	0	0	0	0	0	5919
AH77 Advanced Automotive Technology	12260	5274	12424	13442	14079	14982	15404	15832	Continuing	Continuing
AH79 Air Brake Technology Test	492	0	0	0	0	0	0	0	0	492
AH82 Non-Ozone Depleting Substance Technology	0	0	5473	3682	3184	1393	0	0	0	13732
AH91 Tank & Automotive Technology	18299	15415	15214	14683	15316	16114	15680	17095	Continuing	Continuing

A. Mission Description and Budget Item Justification: This Exploratory Development Program Element (PE) advances the state of technologies leading to development of advanced ground combat and tactical vehicles and components that improve the Army's ability to project force and fight, survive against, and defeat future battlefield threats. Increased emphasis is placed on technologies needed for upgrades to fielded ground vehicles leading to more mobile, digitized, lightweight, versatile and highly survivable ground combat systems essential for the post Cold War era. New technology is also aimed at achieving more deployable future armored vehicles that reflect the Army's need to lighten the force while retaining the ability to survive in diverse, worldwide, flexible battlefield environments. These technologies will provide an intra-vehicular digitization compatibility with horizontal battlefield communication requirements. This PE provides critical new technologies to improve survivability against advanced anti-armor weapons. This PE evaluates non-ozone depleting fire suppressant alternatives to Halon 1301 for armored combat vehicles. This PE funds the National Automotive Center (NAC), an initiative to exploit dual-use, military and commercial automotive technologies by fostering collaborative efforts between government, industry and academia. Work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The PE is managed by U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI. This program adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles with oversight and coordination provided by the Joint Directors of Laboratories. There is no unnecessary duplication of effort within the Army or DoD. Furthermore, the program is coordinated with the Marine Corps office within the Naval Surface Weapons Center and ground vehicle developers within the Departments of Energy, Commerce and Transportation, and the Advanced Research Projects Agency. Projects in this PE include non-system specific development efforts directed toward specific military needs, and therefore are appropriate to Budget Activity 2.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602601A Cmbt Veh And Automotive Tech

Project DC05 - Armor Exploratory Development: This project lays the technical foundation to solve critical armor deficiencies and improve the survivability of conventional ground combat forces against increasingly lethal anti-armor weapons. Supporting the ultimate objective of lighter, more deployable, more survivable combat vehicles, the emphasis is on armor technologies that will be compatible with armors suitable for upgrade of current and emerging combat systems (e.g. Abrams, Bradley, Advanced Field Artillery System, Armored Gun System), and light weight structural technologies of future combat systems. This project focuses on armor technologies to complement innovative survivability techniques such as those described in project AH91 in this PE. Within the broader field of armor development, this project focuses technology on problems unique to the ground combat systems: protection of combat and tactical vehicles against such threats as kinetic energy projectiles, explosively formed penetrators and chemical energy warheads. This project draws upon products from Army programs (e.g., PE/Project 0602618A/AH81), as well as innovative armors from industry, facilitating the transfer of armor products from those programs to Army systems applications. In addition to development of specific armor concepts, the project includes supporting work in armor materials, bringing together the collective expertise of the Department of Defense, the Department of Energy, and industrial and academic sources. Supporting work also includes development and refinement of armor performance models and integration tools necessary to realize the benefits of this technology on the battlefield.

FY 1994 Accomplishments:
- Documented the Protection Areal Density method and implemented a material fracture model for cost efficient ceramic armor design and testing (709)
- Demonstrated passive armor solutions to chemical energy and kinetic energy overhead and horizontal threats (1470)
- Developed integration technology for efficient application of armors for existing vehicles; transitioned passive roof armor concept to Paladin program (4703)

FY 1995 Planned Program:
- Develop energetic armors utilizing self-limiting energetic materials and other techniques to improve vehicle tolerance to effects of high performance armors (3000)
- Demonstrate roof armor systems for protection against advanced overhead threats (e.g. explosively formed penetrator) (1669)
- Demonstrate armors that upgrade existing medium vehicle systems to the level of the advanced medium cannon threat (1580)
- Demonstrate armor technology for enhancing crew survivability in vehicles used in operations other than war (504)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (145)

FY 1996 Planned Program:
- Demonstrate passive and energetic roof armor technologies which can defeat future overhead threats (1850)
- Enhance medium vehicle upgrade armors to defeat both medium caliber cannon and shaped charge threats (1652)
- Demonstrate advanced test analysis and armor design methods for reduction of armor development cost (500)

FY 1997 Planned Program:
- Conduct second generation demonstration of protection technology for vehicles in operations other than war (1800)
- Downselect technology for FY 99 demonstration of advanced armor for the heavy frontal threat (2600)
- Develop and validate armor penetration mechanics model enhanced to include effects of energetic armors (2081)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602601A Cmbt Veh And Automotive Tech

Project DC83 Tractor Card: (CLASSIFIED PROGRAM)

Project AH74 Simulation Laboratory: This project was established in response to Congressional direction and funding to implement an upgrade to the Physical Simulation Laboratory at the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC). This effort will include integrating state of the art technology to enhance the simulation capability of the laboratory. Enhancements will include upgrading of the hydraulic power supply, Crew Station/Turret Motion Base Simulator and Ride Motion Simulator as well as the addition of a computer generated imagery system and additional wheeled vehicle simulators. This enhancement will be integrated into the Crew Station/Turret Motion Base Simulator (CS/TMBS) and the Ride Motion Simulator (RMS) to provide a dynamic simulator in the Army Distributed Interactive Simulation (DIS) Network and will provide realistic vehicle/battlefield sounds to the crew during simulations. This effort will enhance the Army's modeling and simulation capabilities for combat and tactical vehicle research.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Upgrade the hydraulic power supply to increase the maximum flow rate by 40% and provide a larger oil supply (2000)
- Procure a computer generated imagery system to connect to the Army Distributed Interactive Simulation (DIS) Network (1000)
- Procure an audio system for the CS/TMBS and the RMS (50)
- Upgrade the controller on the CS/TMBS to provide more responsiveness and a higher bandwidth (1000)
- Upgrade the RMS to provide a six degree-of-freedom simulator with higher responsiveness (1745)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (124)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project AH77 - Advanced Automotive Technology: This project funds the National Automotive Center (NAC) which fosters automotive research, facilitates automotive and manufacturing development, conducts dual-use technology demonstrations and encourages two-way transfer of dual-use technology. Recent economic and legislative changes encourage the government and the automotive industry to work more closely together and share the large automotive technology base. The NAC, located at TARDEC, serves as a catalyst linking industry, academia and government agencies and as a clearinghouse for the development and exchange of automotive technologies. Initial collaborative research and development (R&D) stresses the application of ongoing commercial R&D to military requirements, and military R&D to commercial needs. Cooperative Research and Development Agreements (CRDAs) are pursued to implement two-way industry/government technology transfer. Government agencies with ground vehicle development missions will be linked under a Memorandum of Agreement to advise and support the activities of the NAC and consolidate the collective expertise of federal government departments such as Energy, Transportation, and Commerce and other Department of Defense (DoD) agencies. The NAC supports the Partnership for the New Generation of Vehicles (PNGV) Program and has been designated as the DoD representative on the PNGV technical working group.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602601A Cmbt Veh And Automotive Tech

FY 1994 Accomplishments:

- Implemented Phase 2 of 27 collaborative R&D contracts (electronics, sensors, materials processes, mobility, simulation and design) begun in FY 1993 to exploit commercially developed technologies for military ground vehicles, signed master CRDAs between the Army and General Motors, Ford and Chrysler (4440)
- Awarded 8 competitive contracts to acquire advanced commercial automotive technologies by tailoring ongoing private R&D for military applications, and identified and assessed technologies of mutual benefit to industry and government (6991)
- Analyzed high payoff dual-use automotive technologies; developed a plan to demonstrate and evaluate ongoing technology by incorporating these technologies into existing military demonstration platforms (829)

FY 1995 Planned Program:

- Evaluate ongoing contracts to award 3rd year funding increment for most promising, high payoff technologies (489)
- Award competitive contracts to acquire advanced commercial automotive technologies (to include engine development for hybrid electric vehicles) by tailoring or adapting ongoing private automotive research for military applications (3475)
- Integrate and evaluate technologies from FY 1993 and FY 1994 contracts by incorporating these technologies into existing military demonstration platforms (1200)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (110)

FY 1996 Planned Program:

- Evaluate ongoing contracts to award funding increments for most promising, high payoff technologies (1500)
- Evaluate and integrate technologies from FY 1994 and FY 1995 contracts into existing military demonstration platforms (1988)
- Participate in joint industry/government demonstrations of advanced automotive technologies (1500)
- Award competitive contracts to acquire advanced commercial automotive technologies by tailoring on-going private automotive research for military applications (7436)

FY 1997 Planned Program:

- Evaluate on-going contracts to award additional funding increments for promising, high-payoff technologies (4000)
- Award competitive contracts to acquire advanced commercial automotive technologies by tailoring on-going private automotive research for military applications (5959)
- Evaluate and integrate technologies from FY 1995 and FY 1996 contracts into existing military demonstration programs (1700)
- Continue joint industry/government demonstrations of advanced automotive technologies (1783)

Project AH79 - Air Brake Technology Test: This project was Congressionally directed, to verify that the operation advantages and maintenance cost reduction of air-applied, mechanically held, non-spring type brake systems can be realized in DoD applications. Due to the potential for dual-use applications, this program is administered by the NAC.

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602601A Cmbt Veh And Automotive Tech

FY 1994 Accomplishments:
- Competitively procured air brake system and installed system on test vehicle (342)
- Evaluated air brake performance and safety (150)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project AH82 - Non-Ozone Depleting Substance Technology: This project demonstrates environmentally and toxicologically acceptable replacements for Halon 1301 in fire suppression systems in crew occupied compartments of ground combat vehicles. Due to the ozone depleting potential of Halon 1301, alternate extinguishing agents are needed to maintain current crew and vehicle survivability and supportability. Funds for this project, as well as related funds for FY 1995 in PE 0603005A were provided for the purpose of identifying and evaluating non-ozone depleting substances for application to military vehicles. The FY 1995 funds were placed in PE 0603005A, and starting in FY 1996, the program has been restructured under exploratory development to more correctly reflect the nature of the planned work. Due to the potential for dual-use applications, this program is administered by the NAC.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program: Project not funded (See PE 0603005A Project D221)

FY 1996 Planned Program:
- Complete performance testing of primary agents (2500)
- Perform Tier 2 toxicity testing (2473)
- Conduct performance and toxicology review (400)
- Select secondary agents to enter into testing (100)

FY 1997 Planned Program:
- Conduct performance testing on secondary agents (1500)
- Complete Tier 2 toxicity studies (200)
- Perform Tier 3 toxicity studies (1832)
- Develop system design guidelines for primary agents (150)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602601A Cmbt Veh And Automotive Tech

Project AH91 - Tank and Automotive Technology: This project provides innovative vehicle concepts and component technologies leading to product improvements to fielded equipment and to the development of future systems that will enable the Army to maintain superiority to fight and survive against diverse threats. Conceptual designs, virtual prototyping, and analyses of ground vehicle systems identify promising emerging technologies and quantify benefits, burdens and trade-offs related to ground vehicle applications. Activities are closely coordinated with, and complement, Army Battle Labs. The program is comprised of six topics: (1) future vehicle concepts and technology integration; (2) mobility; (3) integrated survivability; (4) vehicle electronics (VETRONICS) and digitization; (5) advanced vehicle structures; and (6) simulation/analysis. Technology initiatives are being pursued to address future mobility, survivability and lethality requirements of lighter, digitized, more deployable vehicles. The current M1 Abrams Tank and Bradley Fighting Vehicles have benefited from activities performed in this project. A recent example of a product transitioned to advanced development is the Composite Armored Vehicle (CAV) which transitioned to PE 0603005A in FY 1994 when a demonstration contract was awarded. The survivability technologies, which include non-armor approaches such as signature reduction, countermeasures, and damage reduction, complement, but do not duplicate, the work performed under the armor exploratory development project in this PE (DC05). Under a restructuring of projects, the fuels and lubricants technology work being conducted under PE 0602786A, Project AH20 through FY 1995 is integrated into this project beginning in FY 1996. This project is the Army's ground vehicle applied research program and provides the ground work and strategies for the technology demonstration, follow-on Advanced Technology Demonstrations (ATDs) and Advanced Concept Technology Demonstrations (ACTDs), warfighting experimentation, product improvements and new vehicle developments for both government and automotive industries.

FY 1994 Accomplishments:

- Developed and assessed the battlefield payoff of advanced technology concepts for M1 Abrams system upgrade (Tank 1080), a future Electromagnetic Rail Gun tank, three future Electro-Thermal Chemical Gun tanks, a 40 ton tank; performed trade-off analysis of potential concepts and non-developmental item modifications for an advanced vehicle to meet requirements for operations-other-than -war (2966)
- Completed virtual prototyping plan including virtual manufacturing and software acquisition (885)
- Developed electric drive technology (high tractive effort motors and high temperature power electronics); investigated high performance diesel technology; developed band track designs for test bed assessment; and developed, integrated and began testing active suspension for High Mobility Multipurpose Wheeled Vehicle (HMMWV) (7030)
- Evaluated and tested contractor furnished advanced hardware concepts of laser protection vision devices (654)
- Developed test scenarios and enhanced virtual prototype soldier-in-the-loop simulations to support the Crewman's Associate Advanced Technology Demonstration (CA ATD) (2781)
- Defined and documented current and future combat vehicle electronics architecture requirements (100)
- Completed Composite Armored Vehicle (CAV) studies and transitioned to PE 0603005A (150)
- Procured real time computer and implemented real time vehicle modeling and simulation code to assess feasibility and operational worth of combat vehicle concepts (2533)
- Developed improved modeling of vehicle signatures and awarded contract for design of vehicle top-deck suppressor for infrared and radar signatures (1200)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602601A Cmbt Veh And Automotive Tech

FY 1995 Planned Program:

- Conduct concept studies, through modeling and simulation, for M1 Tank improvements, future light weight deployable tanks, and future scout vehicles, including assessment of battlefield impact and affordability of projected systems and individual technologies (3620)
- Demonstrate advanced combat vehicle electric drive system in the laboratory, conduct semi-active external suspension laboratory unit evaluation, deliver semi-active suspension set and band track for Mobility Technology test bed demonstration; test and evaluate HMMWV with active suspension fuzzy logic controller (6100)
- Tailor laser protected vision devices from multiple contractors for combat vehicle demonstrations (1100)
- Demonstrate and test light weight ballistic signature suppressor to defeat top attack munitions; demonstrate radar treated thermal window concept (1000)
- Conduct Soldier Machine Interface (SMI) concept studies and evaluations through virtual prototype Soldier-in-the-Loop simulations in support of Bradley (M2A3) system modernization, CA ATD, and Anti Armor ATD programs (3136)
- Continue to refine the application of commercial architectures/digitization for upgrades of current systems and Advanced Technology Demonstrations (ATDs) (200)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (259)

FY 1996 Planned Program:

- Develop concepts through modeling, simulations and virtual prototyping for peacekeeping vehicles, Bradley and future infantry vehicles and assess the battlefield impact and affordability of the projected systems and individual technologies through war gaming (4021)
- Fabricate and test hybrid electric drive HMMWV test bed; develop and evaluate active suspension algorithms; develop terrain preview sensor knowledge base requirements; develop active electric suspension concepts; integrate and test semi-active suspension and band track on the Mobility Technology test bed (5019)
- Complete field demonstrations of candidate environmentally compliant combat engine oil candidates (329)
- Develop new analytical capabilities that rapidly define fuel quality in field for eventual incorporation into Petroleum Quality Analysis System (PQA) (247)
- Award competitive contract for prototype of agile protection vision device (1100)
- Demonstrate active noise cancellation acoustic signature suppression; complete visual signature model (905)
- Support the completion of the Crewman's Associate program with Soldier-in-the-Loop Virtual Prototyping (3393)
- Validate architecture performance and automated warfighting functional requirements through VETRONICS System Integration Laboratory (VSIL) integration and experiments (200)

FY 1997 Planned Program:

- Develop vehicle concepts representing superior revolutionary battlefield technologies and quantify their viability both in combat and commercial applications (4477)
- Demonstrate advanced electric drive system in CAV or Bradley Fighting Vehicle System (BFVS); develop noncausal active suspension algorithms using preview sensor data; and demonstrate electric suspension in the laboratory (5080)
- Finalize and transition new analytical capabilities into PQA System and transition to advanced development (385)
- Continue development of prototype agile protection vision device (1000)
- Demonstrate integrated signature management armor (920)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602601A Cmbt Veh And Automotive Tech

- Demonstrate first-ever distributed simulations link between actual vehicle hardware and software integrated into the VETRONICS System Integration Laboratory (VSIL) and the VETRONICS Simulation Facility (2821)

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	39444	28330	25222	24771
Appropriated Value	39444	33506		
Adjustments to Appropriated Value (Total PE)	-1511			
a. SBIR/STTR decrement (-354)				
b. Reprogramming Total (-1157)				
Current President's Budget Submit	37933	33506	39207	38288

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602618A Ballistics Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	29478	25710	28126	33995	36035	39719	39850	40671	Continuing	Continuing
AH80 Ballistics Technology	24021	22755	23249	26875	28041	31670	31793	32407	Continuing	Continuing
AH81 Armor/Anti-Armor Technology	5457	2955	4877	7120	7994	8049	8057	8264	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element (PE) provides ballistic technologies required for defensive (armor) and offensive (anti-armor) weapons systems to counter changing threats. Project AH80 is focused on anti-armor warhead mechanics, penetrator mechanics, munition-target interactions, terminal effects, propulsion dynamics, launch and flight dynamics, remote sensing, and computational physics. It also includes work in hypervelocity penetrators and electro thermal chemical (ETC) technology that will greatly increase anti-armor capabilities. Corresponding emphasis is placed on advanced armor technology and vulnerability, lethality and survivability analyses and efforts to optimize effectiveness and survivability of armored combat vehicles. Project AH81 taps the innovation of industry and pursues the most promising and affordable approaches to developing armor/anti-armor technologies. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project AH80 - Ballistics Technology: This project produces ballistic technologies required for offensive and defensive materiel in response to heavy, medium and light threats in a global context. This project contains ballistic technology advances in vehicle survivability, direct fire armament capabilities, indirect fire support, and weapon effectiveness evaluation in order to be able to design the most lethal weapon capabilities and optimally protect against the most dangerous threats. The Army will leverage Navy PEs 0603795N and PE 0603217N and Defense Nuclear Agency PE 0602715H ETC activities during ETC technology demonstrations. Also, emphasis is placed on advancement of simulation and modeling technologies to foster the establishment of the electronic battlefield and exploitation of the Army's supercomputer network. This project continues to support extensive experimental programs to advance the state-of-the-art of ballistics technologies.

FY 1994 Accomplishments:

- Expanded hybrid integrated ram (HIRAM) large caliber facility to achieve ram acceleration of high mass (3-5 kilograms) projectiles to hypervelocity (> 2.1 kilometers/second). (3440)
- Designed and demonstrated critical constructs for indirect and direct fire systems, including increased projectile payload capability and enhanced accuracy and lethality. (9606)
- Demonstrated a prototype self-contained inertial reticle system as a fire control device. (2349)
- Developed tools, techniques and methodology to improve vulnerability/lethality analyses for terminal ballistics and external blast. (5775)
- Developed resin transfer and injection molding simulation algorithms and software for manufacturing composite components for Comanche and the composite armored vehicle. (2851)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602618A Ballistics Technology

FY 1995 Planned Program:

- Finalize designs for a weaponizable reverse annular piston liquid propellant gun and demonstrate muzzle velocity enhancement for solid propellant electro thermal chemical (ETC) concepts. (2647)
- For indirect fire, demonstrate an all-composite HICAP prototype with equivalent payload mass; for direct fire, design an advanced sabot for long rod penetrators. (5903)
- Evaluate ability of ceramic/composite armor concepts to defeat novel Kinetic Energy penetrators. (5249)
- Evaluate performance of a moving inertial reticle system against moving targets; evaluate preliminary north finding technologies with 0.5 degree accuracy and make down selection. (2594)
- Develop next generation vulnerability, lethality and survivability methodologies for analyzing conventional ballistics using the multi-platform unix vulnerability estimation suite (MUVES) environment. (4267)
- Extend resin transfer and injection molding simulation into a synthetic environment for manufacturing composite pre-forms and material insertion. (2095)

FY 1996 Planned Program:

- Investigate diode laser technology for the direct ignition of solid/liquid propellants and models inbore and free flight projectile stability, surface heating and ablation of hypervelocity projectiles. (3968)
- Demonstrate an armor capable of defeating projectiles over a wide velocity spectrum; optimize a self-protection system utilizing an electrically launched rod/plate to counter incoming projectiles. (4316)
- Integrate ETC tank cartridge (plasma generator, bullets, propellant), and demonstrate improved electrical enhancement factors while maintaining enhanced performance. (500)
- For spinning projectiles or submunitions, develop a rotation-compensated warhead concept; for long rod penetrators, demonstrate a micro-rocket motor to reduce drag. (5345)
- Integrate target acquisition, image stabilization and target cueing with the inertial reticle system fire control for secondary armament. (2674)
- Develop methodologies to improve vulnerability and lethality analyses for ballistic shock and use vulnerability codes to enhance the visual display of solids (for armor penetration). (4327)
- Develop software for thick composite resin process for composite hull. (2119)

FY 1997 Planned Program:

- Demonstrate an optimized high-density/high-energy solid electrothermal/chemical propellant and develop multi-dimensional hydrocode for electro thermal chemical concepts. (4276)
- Fabricate a prototype artillery projectile capable of providing gliding flight utilizing attitude control and demonstrate a rotation-compensated explosive device for use on spinning projectiles or submunitions. (4308)
- Develop an inertial reticle fire control system for secondary armament for potential application to an M1A2 tank. (4884)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602618A Ballistics Technology

- Design a full-scale pro-active armor system based on the results of a FY 96 range demonstration of an electrically launched munition countering an incoming kinetic energy threat. (3441)
- In an ETC gun, demonstrate a 25% muzzle energy increase at electrical enhancement factors > 3. (3000)
- Develop a prototype interactive ballistic vulnerability/lethality module to interface with the distributed interactive simulation (DIS) environment for more realistic war gaming. (4676)
- Apply resin transfer molding models and validate against experimental manufacturing processes. (2290)

Project AH81 - Armor/Anti-Armor Technology - The overall objective of this project is to provide significantly increased levels of protection and survivability to existing and future combat systems, and to provide significantly increased lethality and effectiveness to existing and future anti-armor munitions by seeking novel and innovative solutions from industry. This project began as a joint program among the U.S. Army, Advanced Research Projects Agency (ARPA) PE 6?2702E, and the U.S. Marine Corps to enhance the national capability in armor/anti-armor (A3) technologies. The primary armor thrust is overhead protection for all classes of vehicles from tactical vehicles used in contingency operations to heavy combat vehicles. The program has transitioned to the Army.

FY 1994 Accomplishments:
- Developed U.S. manufacturing capability for cubic boron nitride appropriate for lightweight personnel and aircraft armor. (1495)
- Utilized new concepts for precision warhead liners that permit exact scaling of the alternative warhead design. (2170)
- Completed design and hardware fabrication for a candidate lightweight Javelin precursor employing the free form shaped charge concept. (1792)

FY 1995 Planned Program:
- Examine and baseline selected warhead concepts for defeat of a new class of armor protection. (116)
- Prove out gun launch of KE precursor concepts for defeat of reactive range targets. (768)
- Initiate top attack armor technology development with two competing contractor teams. (2009)
- Funds will be reprogrammed for SBIR/STTR Programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (62)

FY 1996 Planned Program:
- Develop warheads and penetrators capable of defeating a new class of armor protection. (1001)
- Perform livefire tests to defeat reactive appliqué target with gun launched KE projectiles incorporating KE precursor concepts. (1538)
- Select and demonstrate the best technical approach for two overhead armors, one for heavy combat vehicles, such as AFAS, one for light vehicles. (1990)
- Initiate development of fuze for Active Protection Systems (APS) defeat (348)

FY 1997 Planned Program:
- Conduct a laboratory test of anti-armor technologies to defeat a new class of armor protection. (1405)
- Select and develop KE precursor concepts for defeat of a new class of armor protection (2477)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602618A Ballistics Technology

- Complete development of overhead protection armors and transition to system managers as appropriate. (2488)
- Continue development of fuze for APS defeat (750)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	29510	25692	28437	31405
Appropriated Value	29510	25710		
Adjustments to Appropriated Value	-32			
a. SBIR/STTR decrement (-88)				
b. Reprogramming (+56)				
Current President's Budget Submit	29478	25710	28126	33995

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602618A Ballistics Technology		PROJECT: AH80

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH80 Ballistics Technology	24021	22755	23249	26875	28041	31670	31793	32407	Continuing	Continuing

C. **Other Program Funding Summary:** N/A

D. **Schedule Profile:** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Ballistics Technology, therefore no milestones or events are provided.

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DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602618A Ballistics Technology

PROJECT: AH81

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH81 Armor/Anti-Armor Technology	5457	2955	4877	7120	7994	8049	8057	8264	Continuing	Continuing

C. **Other Program Funding Summary**: N/A

D. **Schedule Profile**: The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Ballistics Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2. - Exploratory Development

PE NUMBER AND TITLE: 0602622A Chem, Smoke And Equip Defeating Tech

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	39554	31646	1891	1930	2316	2984	3484	3575	Continuing	Continuing
A552 Smoke/Novel Effects Munitions	4025	2032	1891	1930	2316	2984	3484	3575	Continuing	Continuing
A553 Chemical/Biological (CB) Defense & General Investigations*	35529	29614	0	0	0	0	0	0	0	65143

* Funds transfer to DoD PE 0602384BP in FY 1996.

A. **Mission Description and Budget Item Justification**: This program element provides exploratory development of technologies to enhance the ability of U. S. forces to deter and defend against chemical and biological (CB) warfare, increase survivability with enhanced smoke and obscurant capabilities, and solve critical light force deficiencies to defeat enemy targets (i.e., non-lethal and flame/incendiary devices). The Army is the DoD Executive Agent for Chemical Warfare (CW) and Chemical and Biological Defense (CBD) research. This program element provides technologies critical to counterproliferation. Despite the significant progress made towards bi- and multi-lateral treaties, the probability of U. S. forces encountering chemical or biological agents during conflicts around the globe remains extremely high. More than 25 countries have the capability to deliver chemical agents and the use of chemical weapons has been documented in recent third world conflicts. The curtailment of an active U.S. chemical munitions development program drives the need for a significant improvement in CB defense materiel to serve as a deterrent and guard against technological surprise. A robust defense should reduce the probability of a CB attack and enable U.S. forces to survive, continue operations in a CB environment, and win. Exploratory development is conducted for all the services in areas that include Chemical/Biological Defense and General Investigations (Project A553), consisting of: contamination avoidance through reconnaissance, detection, identification and warning; individual and collective protection; decontamination; CB defense technologies, anti-terrorism and support to the Program Executive Officer, Armored Systems Modernization (PEO, ASM). Public Law 103-160 realigns funding for chemical/biological defense from the Services and consolidates it at the OSD level beginning in FY 1996 (PE 0602384BP). Project A552 provides exploratory development of several capabilities essential to countermeasure enemy weapons systems and to provide the overall capability of degrading or defeating the mission of the enemy. Improved multispectral smokes/obscurants will be explored to enhance survivability by providing effective and efficient screening of deployed forces from threat force surveillance sensors and effective defeat of target acquisition devices, missile guidance, and directed energy weapons, all of which can operate anywhere within the visible through the microwave region of the electromagnetic spectrum. These systems will be designed to be safe and environmentally acceptable. Also under Project A552, flame and incendiary payloads will be developed to defeat a variety of targets ranging from personnel to bunkers and light armored vehicles. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. Efforts under this PE transition and provide risk reduction for Demonstration/Validation and Engineering Development programs supported by PE 0603759A/0603384BP (Chemical Biological Defense Systems Advanced Development), PE 0603806A/0603884BP (Demonstration/Validation), PE 0604806A/ 0604384BP (Engineering and Manufacturing

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602622A Chem, Smoke And Equip Defeating Tech

Development) and PE 0605384BP (Operational Development). Efforts in this Program Element include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project A552 - Smoke/Novel Effects Munitions - This project addresses the urgent need to provide smoke and obscurants to reduce the vulnerability of U.S. forces by defeating or degrading Reconnaissance/Surveillance/Target Acquisition (RSTA) capabilities, directed energy weapons and smart sensors, by providing covert marking for identification friend/foe (IFF), search and rescue, and target marking. This project also provides technology essential to development of novel flame and incendiary payloads.

FY 1994 Accomplishments:

- Developed and evaluated multi-component/multispectral smoke materials, evaluated feasibility of degradable Millimeter Wave (MMW) material; evaluated multispectral material produced from JP8 feedstock (1788)
- Fabricated and demonstrated Electro-Optic (EO) countermeasure decoy smoke grenade against Infrared (IR) sensor (350)
- Fabricated and tested 3 EO smoke marker designs for day/night decoy marking of targets and terrain in support of Close Air Support (350)
- Established capability to simulate/evaluate obscurant effect on smart sensors (200)
- Evaluated high energy materials and supported conceptual flame warhead technology program (300)
- Developed flame effectiveness evaluation methodology for thermal and blast overpressure effects for military operations in urban terrain (MOUT) and bunker targets (300)
- Completed design of enhanced incendiary grenade, conducted demonstration for user and transition as a soldier enhancement program (380)
- Investigated novel methods to destroy or prevent aerosolization of biological agents when production facilities and storage areas are attacked with conventional high explosive munitions; investigated use of aqueous foams (135)
- Completed Front End Analysis and Master Plan for Flame/Incendiary Weapons (222)

FY 1995 Planned Program:

- Evaluate feasibility of degradable MMW materials; initiate modeling and simulation studies of MMW defeat of smart sensors (1204)
- Conduct technical watch on flame and non-lethal technologies (100)
- Investigate novel methods to defeat or prevent aerosolization of CB agents when production facilities and storage areas are attacked with conventional high explosive munitions (75)
- Evaluate inhalation toxicology for pepper mace (200)
- Evaluate novel smoke/obscurant/marking materials (410)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (43)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602622A Chem, Smoke And Equip Defeating Tech

FY 1996 Planned Program:

- Evaluate degradable and environmentally safe MMW screening obscurant candidates; conduct modeling and simulation of MMW screening defeat mechanism; initiate packaging and dissemination studies of candidate degradable MMW material (1500)
- Investigate novel methods to defeat or prevent aerosolization of CB agents when production facilities and storage areas are attacked with conventional high explosive munitions (191)
- Conduct technical watch on flame and non-lethal technology (100)
- Evaluate novel smoke/obscurant/marking materials (100)

FY 1997 Planned Program:

- Evaluate degradable and environmentally safe MMW screening obscurant candidates and conduct field trails; conduct packaging and dissemination studies (1735)
- Investigate novel methods to defeat or prevent aerosolization of CB agents when production facilities and storage areas are attacked with conventional high explosive munitions (155)
- Conduct technical watch on flame and non-lethal technology (100)

Project A553 - Chemical/Biological (CB) Defense and General Investigations - This project addresses the urgent need to provide all services with defensive materiel to protect individuals and groups from threat chemical-biological agents in the areas of detection, identification and warning; contamination avoidance through reconnaissance; individual and collective protection and decontamination. It also provides for special investigations into CB defense technology to include CB threat agents, operational sciences, modeling, CB simulants, and nuclear, biological, chemical (NBC) survivability. This project also addresses support to Program Executive Offices focusing on horizontal integration of CB defensive technologies across the armored force. Public Law 103-160 realigns chemical/biological funding from the Services and consolidates it at the OSD level in FY 1996 (PE 0602384BP).

FY 1994 Accomplishments:

- Transitioned bio-detection kit program to production; transitioned improved sorbent Decon to Dem/Val (1400)
- Demonstrated low power tunable ultraviolet laser for improved biological discrimination; improved biological identification data base (9553)
- Conducted studies on recombinant antibodies and developed Deoxynucleic Acid (DNA) library for genes of specific antibodies and express in bacterial system (1565)
- Fabricated and tested infrared and Laser Standoff Chemical Detector breadboard systems and determined operational parameters and limitations; conducted system modeling (2675)
- Finalized component design and evaluated facepiece and components for the advanced respiratory protection mask; and investigated new materials and manufacturing technologies for future/novel respirator designs and conducted physiological performance evaluations of new mask concepts (1500)
- Fabricated and tested lab scale temperature swing absorption filtration and developed data base of performance characteristics for collective protection (1400)
- Evaluated new sorbents and sorbent mixtures for improved filtration performance; tested a new Canadian designed filter canister and transitioned to production (1115)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602622A Chem, Smoke And Equip Defeating Tech

- Established design parameters for pressure swing adsorption/catalytic air filtration and transitioned to Program Manager, Advanced Field Artillery System; investigated filtration, detection, and obscuration system concepts for combat systems (6457)
- Evaluated reduced-pH hydrolysis catalysts and investigated methodology for examining agent-decontaminant interaction in solid matrices (1170)
- Integrated chemical models into conventional Army war game scenarios; investigated new CB threat agents and tested methodology for evaluating performance of equipment in a CB environment (8694)

FY 1995 Planned Program:

- Evaluate Bio Agent point detection technologies such as DNA Probes, electrospray mass spectrometry, planar wave guides and flow cytometry; and technologies for stand-off biological detection (10912)
- Evaluate cloning bacterial fermentation to produce large quantities of antibodies more cost effectively (1200)
- Conduct studies to optimize integration of future/novel respirator designs to soldier system concepts and standardize mask performance evaluation rating methodology (1848)
- Evaluate limits of performance for regenerable filtration concepts and rapid obscuration concepts for combat vehicles (4660)
- Develop a quantitative mechanism to determine decon reactions in solids; characterize catalysts and polymers with agent reactive sites for increased activity (462)
- Expand CB battlefield modeling efforts supporting the development of a Distributed Interactive Simulation (DIS) capability for CB warfare war gaming (2000)
- Complete demo on Lightweight Standoff Chemical Agent Detector and transition to engineering/manufacturing development (1500)
- Evaluate technologies for an Individual Soldier Chemical Detector (1230)
- Evaluate novel technologies for chemical images, CB anti-terrorism, laser standoff chemical detection; develop standardized test methodologies for CB evaluation; expand laboratory analysis capability for special projects (3768)
- Conduct feasibility investigation of promising biological point detection technologies; integrate the CB environment and environmental effects into DIS ; complete testing to transition the sorbent decontamination program to demonstration/validation; conduct investigation of technologies to improve protection factor of respiratory protection; conduct inhalation toxicology studies on new materials (2034)

FY 1996 Planned Program: Funded under DoD PE 0602384BP.

FY 1997 Planned Program: Funded under DoD PE 0602384BP.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602622A Chem, Smoke And Equip Defeating Tech

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	39537	29657	25670	25745
Appropriated Value	39537	31646		
Adjustments to Appropriated Value	+17			
a. SBIR/STTR decrement (-49)				
b. Reprogramming total (+66)				
Current President's Budget Submit	39554	31646	1891	1990

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602622A Chem, Smoke And Equip Defeating Tech PROJECT A552

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A552 Smoke/Novel Effects Munitions	4025	2032	1891	1990	2316	2984	3484	3575	Continuing	Continuing

C. **Other Program Funding Summary**: See para A.

D. **Schedule Profile**: The efforts funded in these projects are non-system specific and represent continuing exploratory development research in the area of CBD, therefore no milestones or events are provided.

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DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602622A Chem, Smoke And Equip Defeating Tech

PROJECT: A553

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A553 Chemical/Biological (CB) Defense & General Investigations*	35529	29614	0	0	0	0	0	0	0	65143

C. **Other Program Funding Summary**: See para A.

D. **Schedule Profile**: The efforts funded in these projects are non-system specific and represent continuing exploratory development research in the area of CBD, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602623A Joint Service Small Arms Program

PROJECT: AH21

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH21 Joint Service Small Arms Program (JSSAP)	3393	5688	5114	4839	5165	5266	5148	5159	Continuing	Continuing

A. Mission Description and Budget Item Justification : The objective of this Program Element (PE) is to develop key technologies that will enhance the fighting ability and survivability of dismounted battlefield personnel across all the Services. This PE funds several efforts including the following: component technology for a weapon to replace selected M249 Squad Automatic Weapons, the M60 machine gun, the M2 machine gun, and the MK19 grenade machine gun; bursting munitions technology to provide a 200% to 300% increase in hit probability and maximize the range of the Objective Individual Combat Weapon (OICW) to 1000 meters; non-conventional target effects technologies to achieve size levels compatible with weaponization for small arms (individual and crew-served) directed energy systems (lasers/acoustics/microwaves) providing increased hit/incapacitation/suppression capabilities with controllable target effects (lethal to less-than-lethal); other fighting technology alternatives promoting significant generic advances in function or form of small arms via a spectrum of applications from product improvements through all new weapon concepts (focusing initially on advanced materials and structures for gun systems, guided bullets, and explosively launched projectiles); personal defense weapon technology leading to a more effective Objective Personal Defense Weapon (hit probability of .9 at 50 meters); and an objective sniper weapon technology to increase accuracy and effective range to 2000 meters for the next sniper weapon. The bursting munition technology development supports the OICW Advanced Technology Demonstration (ATD) and the 21st Century Land Warrior (21 CLW) program. All Joint Service Small Arms Program (JSSAP) efforts are based upon approved Joint Service Science and Technology Objectives (JSSTO) and the Joint Service Small Arms Master Plan (JSSAMP). The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armaments Research, Development and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0601102A (Defense Research Sciences), PE 0602624A (Weapons and Munitions Technology), PE 0603607A (Joint Service Small Arms Program), and will transition to JSSAP efforts conducted in PE 0603802A (Weapons and Munitions-Advanced Development). This project includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2.

Project AH21 - Joint Service Small Arms Program

FY 1994 Accomplishments:

- Transitioned Bursting Munitions technology to the advanced technology development of OICW project for 21CLW (100)
- Awarded multiple contracts for the Objective Crew-Served Weapon (OCSW) to include concept exploration and definition and effectiveness analysis/technology
- assessment; began trade-off determination/system conceptualization (2345)
- Documented initial concept feasibility investigation of chemical laser and acoustic weapon technologies (773)
- Conducted Broad Agency Announcement (BAA) for Non-Conventional Target Effects (NCTE) and Fighting Technology Alternatives (FTA) (175)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602623A Joint Service Small Arms Program / PROJECT: AH21

FY 1995 Planned Program

- Evaluate Crew-Served Weapon concept definitions and analyze and downselect to the most promising approach for component demonstration (4749)
- Award multi-phase competitive BAA contracts for NCTE and FTA (569)
- Conduct Blue Team technology review/evaluation of BAA Phase I efforts (300)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (70)

FY 1996 Planned Program

- Fabricate sub-system components for Crew-Served Weapon (1020)
- Prove out critical component technologies for Crew-Served Weapon (968)
- Integrate Crew-Served Weapon sub-system components into prototype design (990)
- Transition Crew-Served system to the advanced technology development of Objective Crew Served Weapon project (100)
- Award BAA Phase II, feasibility demonstration contracts for follow-on NCTE and FTA efforts and deliver feasibility demo test plan (2036)

FY 1997 Planned Program:

- Complete BAA Phase II, feasibility demonstrations for NCTE and FTA (2417)
- Identify/select technology initiatives for a new personal defense weapon and prepare for contract award (600)
- Conduct a broad review of technology applicable to a new sniper weapon and complete preparation for FY 1998 contract award (812)
- Conduct a BAA for Pre-Planned Product Improvement of the Objective Family of Small Arms, focusing on individual and crew weapons (1010)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	3393	5326	3166	3423
Appropriated Value	3393	5688		
Current President's Budget	3393	5688	5114	4839

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile The efforts funded in this project are non-system specific and represent exploratory development in the area of Small Arms Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602624A Weapons & Munitions Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	34845	36209	23968	24251	28611	31531	32134	32958	Continuing	Continuing
AH18 Artillery & Combat Support Technology	17183	14622	11332	10512	12039	12903	12980	13367	Continuing	Continuing
AH19 Close Combat Weaponry	7864	5274	5057	5451	7888	9083	9597	9790	Continuing	Continuing
AH22 High Explosive Materials	984	7892	0	0	0	0	0	0	0	8876
AH28 Munitions Technology	8814	8421	7579	8288	8684	9545	9557	9801	Continuing	Continuing

A. Mission Description and Budget Item Justification The object of this Program Element (PE) is to develop technologies for advanced direct and indirect fire weapons (except small arms) and munitions. The PE funds several efforts, including the following: advanced weapon concepts and analysis supporting the Rapid Force Projection Initiative (RFPI) demonstration of increased anti-armor capabilities and increased survivability for Early Entry Forces; the Direct Fire Lethality Initiative, by developing technologies for precursor defeat of explosive reactive armor (ERA), advanced composite sabots, in-flight trajectory correction, smart barrel actuators and modeling and analytic codes for thermal analysis to reduce wear on gun tubes, which degrades accuracy; Insensitive Munitions (IM) technology development for increased survivability of combat vehicles and safety in explosive manufacturing and storage facilities, including process prove-outs of energetic materials and binders; high energy explosive technologies that increase projectile and warhead lethality; and advanced armament fire control systems, advanced overwatch systems for smart mines, and supporting technology advances in mine warfare and demolitions. This PE also funds several additional efforts, including: advanced gun propulsion technologies; low collateral damage and less-than-lethal munition technologies; automatic loader and munition transfer mechanisms for large caliber weapons and storage devices; development of automated design and demonstration techniques in accordance with Army Battle Labs initiatives and wargame scenarios; the use of lightweight composite materials in weapons; the application of novel gun recoil concepts and techniques; extended range cargo-carrying projectile technology; and projectile concepts featuring an integral, near real time, battle damage assessment capability. This PE also includes work on thermal management of high performance, high rate of fire, large caliber guns, and advanced air-to-air guns for rotary wing aircraft (e.g., Apache and Comanche). The work in this PE is consistent with the resource constrained Army Science & Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armaments Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0602618A (Ballistics Technology), PE 0602623A (Joint Service Small Arms Program), and transitions to work performed in PE 0603004A (Weapons & Munitions Advanced Technology), PE 0603607A (Joint Service Small Arms Program) and PE 0603802 (Weapons and Munitions Advanced Development). These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project AH18 - Artillery and Combat Support Technology: This project focuses on the exploratory development of technology for cannon artillery, mortar weapon, fire control and combat support systems. This project funds technology development which supports the Intelligent Minefield (IMF) and Precision Guided Mortar Munition

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602624A Weapons & Munitions Technology

(PGMM) Advanced Technology Demonstrations (ATDs). This project also develops advanced sensors in support of the RFPI Advanced Concept Technology Demonstration (ACTD). A solution to 155mm artillery range deficiencies identified during Operation Desert Storm is being pursued through development of embedded projectile fuzing, baseburn and ogive mounted rocket technology for the XM982 Extended Range Artillery (ERA) projectile. Technology to improve a turreted vehicles' first round hit probability is being pursued through the development of "smart" barrel acuators and a gearless turret drive concept. Decision aid technology is being developed to increase battlefield survivability for self-propelled howitzers, along with technologies for improving the effectiveness and affordability of next generation precision guided munitions. Concepts are being developed to provide future battle commanders with a Battle Damage Assessment (BDA) capability via artillery-fired projectiles with capabilities for inflight video imaging and targeting of the battlefield. New Low Cost Competent Munition (LCCM) concepts utilizing Global Positioning System (GPS) technology are being applied to artillery projectiles to increase first and subsequent round hit probabilities. Lightweight composite componentry and howitzer recoil management concepts are also under evaluation to support development of the next generation Lightweight Automated Howitzer (LAH) having improved strategic and tactical mobility. Technology for artillery projectile rotating and obturating bands is being pursued to address an imminent shortcoming when firing from high performance cannons. This project also supports power supply development for electric gun technology applications.

FY 1994 Accomplishments:

- Conducted advanced acoustic sensor array demonstration showing capability of real time, 2-dimensional tracking at ranges in excess of 1km in support of Intelligent Minefield (IMF) (2179)
- Performed ballistic testing of key XM982 projectile components (i.e., baseburn grain, rocket grain, expulsion system embedded fuze); demonstrated structural integrity of 2-piece composite high capacity artillery projectile (HICAP) (1340)
- Performed captive flight tests of laser radar (LADAR) sensor technology and high resolution video to obtain resolution vs. altitude data for battlefield imaging projectile systems (BIPS) (1998)
- Completed software design specification and developed prototype for a route planning decision aid module for self-propelled artillery (1621)
- Developed prototype concept and participated in the RFPI Early Version Demonstration of a light weight 155mm towed howitzer (536)
- Performed 120mm mortar ballistic and aerodynamic analyses to determine optimum profile for extended ranges (1731)
- Supported RFPI program simulation and participated in wargaming scenarios for Battle Labs (1363)
- Performed experiments to verify computer models of electromagnetic (EM) launcher physics; experimentally verified EM launch models of EM in-bore ballistics; performed diagnostic experiments of EM launch environments (4322)
- Conducted firing test of 2 LCCM Auto Registration Modules with GPS in a North Atlantic Treaty Organization standard fuze configuration (2093)

FY 1995 Planned Program:

- Demonstrate advanced acoustic sensor brassboard and integrate into IMF ATD; conduct IMF acoustic sensor data collection exercise (1960)
- Complete coding of decision aid self-defense module for self-propelled artillery; conduct full-scale gun launch of 2-piece composite HICAP projectile; complete Lightweight Automated Howitzer (LAH) trade-off studies; support electro-rheological (ER) fluid recoil design (2240)
- Complete design of 120mm mortar rocket motor concept for extended range (993)
- Complete design of gearless turret drive sub-systems for integration into M1A1 test bed (750)

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- Verify computer models of EM launch physics; complete design studies on long life EM gun barrels and advanced armatures; complete development efforts of full scale EM launcher technology and Self Excited Air-Core Compulsator gun system (3875)
- Conduct trade-off study of three low cost competent munition (LCCM) concepts and initiate program to demonstrate a Canard Module on a spinning shell ; conduct design study of optimum 155mm artillery rotating band and obturating band materials and profiles for high performance applications (2459)
- Conduct Captive Flight Testing (CFT) of Battlefield Imaging Projectile System (BIPS) components and evaluate Covert Data Link for battlefield environments (600)
- Fabricate XM982 projectile prototypes; demonstrate 50km range and in-flight cargo delivery (600)
- Support RFPI program simulations for IMF, PGMM and LAH (1145)

FY 1996 Planned Program:

- Conduct field tests of IMF acoustic sensor and support test planning for RFPI ACTD (1982)
- Fabricate gearless turret drive (GTD) hull-to-turret components (1301)
- Design and fabricate a rapid access P-Code GPS receiver for LCCM applications and conduct flight test of Canard Module demonstrating stability and maneuver capability (2137)
- Conduct man-in-the-loop testing of Route Planning and Self Defense decision aid modules for advanced field artillery (400)
- Complete parafoil testing and finalize parafoil design for BIPS, incorporate GPS and evaluate LADAR sensor for parafoil drop demonstration (1800)
- Conduct range accuracy test and in-flight fuzing test of 2-piece composite HICAP projectile (600)
- Complete gearless gun elevation design and fabricate smart barrel actuator components for XM291 gun (1301)
- Fabricate high performance rotating and obturating band alternatives; develop band bonding techniques (1175)
- Support RFPI program simulations of IMF, PGMM and LAH (636)

FY 1997 Planned Program:

- Continue high density, long life power source technology development for next generation emplaced munitions (1007)
- Initiate concept studies for enhanced Wide Area Mine (WAM) with extended sensing range and lethality (990)
- Conduct confirmatory flight test of low cost competent munition (LCCM) concept utilizing GPS for improved accuracy (2861)
- Integrate gearless turret drive prototype into M1A1 tank; fabricate gearless gun elevation components and integrate M1A1 test bed; demonstrate smart barrel actuators on XM291 gun (1464)
- Demonstrate high performance artillery projectile obturating band and rotating band designs statically and ballistically under new and worn tube conditions (532)
- Support RFPI program simulations of IMF, PGMM and LAH (600)
- Continue pulse power supply development for Electric Gun Applications (1000)
- Conduct auto target recognition (ATR) testing and high-G survivability of high resolution video and laser radar (LADAR) components, design ground base video / GPS receiving station (1331)
- Initiate concept studies of acoustic based anti-cruise missile defense system (727)

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Project AH19 - Close Combat Weaponry: The objective of this project is to exploit and advance new technologies which will demonstrate significant improvements in direct fire cannon performance for ground and air combat vehicles. Principal efforts are the Direct Fire Lethality Program and Low Collateral Damage/Less-Than-Lethal Munitions. Included are technologies for the precursor defeat of explosive reactive armor (ERA), composites for sabots and gun structures, trajectory correction mechanisms, smart barrel actuators to increase accuracy, optical, acoustic and kinetic energy devices to deter threats without excessive collateral damage. In addition, this project develops basic technologies in the areas of weapon stabilization, projectile design and fabrication, thermal management of high rate launch mechanisms and munition loaders, feeders and storage mechanisms. This project provides opportunities for longer range, more accurate and more lethal cannon systems for armored vehicle upgrades (e.g., Abrams, Bradley Fighting Vehicle System (BFVS)) and for future systems. The approach will be to develop both the hardware and analytical tools necessary to assess system performance, identify problem areas and to develop solutions.

FY 1994 Accomplishments:

- Provided modeling support to the office of Special Operations/ Low Intensity Conflict ,OASD (SO/LIC) PP, for low collateral damage/less-than-lethal weaponization (100)
- Demonstrated baseline directed energy air defense module and radio frequency projectile design and delivered 500 40mm less-than-lethal cartridges to Special Operations Command for user tests (2812)
- Designed, built and tested staging mechanism for a precursor to defeat ERA and conducted instrumented live fire tests of 25 and 120mm obturator and composite sabots (2975)
- Demonstrated track/integrated sight with closed loop fire control on M2 fighting vehicle for Program Managers of the Bradley and Tube-launched, Optically Tracked, Wire Command-Linked Guided TOW weapon system (1318)
- Demonstrated simulated armament system at Moffett Field in an Apache simulator (659)

FY 1995 Planned Program:

- Continue modeling support to OASD (SO/LIC) PP on low collateral damage/less-than-lethal munitions and test non-lethal concepts in an operational environment (1723)
- Complete subsystem testing of composite sabots and precursor defeat of ERA and transition to advanced technology development (2026)
- Test panoramic sight and transition for Crewman's Associate and Target Acquisition ATDs; complete design of compact autoloader (895)
- Develop automated gun design and analysis capability for applications to AH64 Apache, Bradley and secondary armament for Abrams (630)

FY 1996 Planned Program:

- Award contract(s) and conduct user coordinated technology down-select for low collateral damage/less-than-lethal munitions (1892)
- Perform integration demonstration of enhanced accuracy kinetic energy penetrator and transition to Program Manager Tank Main Armament Systems (PM-TMAS); design/fabricate smart actuator for more accurate tank gun control; validate thermal and erosion analysis modeling codes (2118)
- Complete fabrication of compact tank main armament autoloader and initiate integration into M1A1 battle tank (697)
- Demonstrate high fidelity generic gun design and analysis capability (350)

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FY 1997 Planned Program:
- Conduct user tests and assessments of low collateral damage/less-than-lethal munitions (2220)
- Design and test novel defeat mechanisms against passive and reactive armor, demonstrate reduced wear gun tube coatings and obturators and transition to PM-Bradley and PM-TMAS (2158)
- Demonstrate a direct fire autonomous weapon system (723)
- Use high fidelity gun design and analysis to develop armaments concepts for BFV/S, US Marine Corps Advanced Amphibious Assault Vehicle, and Phalanx II (350)

Project AH22 - High Explosive Materials: This project was initiated in FY 1994 in response to Congressional direction to conduct feasibility tests and process prove-outs of energetic materials and binders from low sample test quantities to small scale production. This project develops process technology for pilot lot production required to reduce costs, comply with environmental laws, eliminate pollution problems, and comply with international agreements.

FY 1994 Accomplishments:
- Develop processes to correct safety, environmental, and sole source dependency problems in pyrotechnic manufacturing of red powder (to be accomplished in FY 95) (492)
- Develop pilot plant processes for prove out of production of more powerful explosives (to be accomplished in FY 95) (492)

FY 1995 Planned Program:
- Scale-up process for red powder and demonstrate in twin screw extruder (3824)
- Demonstrate a less costly, environmentally friendly process for production of Geocenters/ARDEC Her Majesty Explosive (GARDEC HMX) (1000)
- Demonstrate a process for plastic explosives taggant (this effort is in response to an international agreement resulting from the Pan Am terrorist incident) (1000)
- Improve and scale-up TNAZ, CL20, imidozoles and nitro-cubanes (1902)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (166)

FY 1996 Planned Program: Project Not Funded

FY 1997 Planned Program: Project Not Funded

Project AH28 - Munitions Technology: This project supports weapon system developments and advanced technologies in the areas of propellants, explosives, warheads, ammunition packaging, pyrotechnics and penetrators. Advances in warhead technology will provide improved explosively formed penetrators (EFP), shaped charges and heavy metal alloy penetrators and liners to defeat the current and future threat systems. High energy/density explosives developed will increase light material anti-armor and multi-target lethality. Under the auspices of the Joint Technical Coordinating Group (JTCG)/Air-Craft Survivability improved pyrotechnic decoys will be developed to protect low flying/slow aircraft (helicopters) against the advanced imaging infrared missile threat. This complements but does not duplicate Air Force programs to

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develop decoys to protect high speed/high altitude fixed wing aircraft. The Imaging Seeker Decoy will transition to advanced technology development in FY 97. The IM efforts conducted in this project will increase the survivability of tanks, artillery, helicopters and infantry fighting vehicles, as well as safety in manufacturing plants and storage depots.

FY 1994 Accomplishments:

- Increased synthesis of insensitive Picatinny Arsenal Explosive (PAX) to 100 pounds/batch level for potential application to Hellfire, Javelin and The Army Combined Arms Weapon System (TACAWS) warheads (1300)
- Conducted laboratory tests on more powerful trinitroazetidine (TNAZ) explosives and increased TNAZ synthesis to 250 lbs for EFP anti-armor warhead effectiveness live fire tests for potential application to smart munitions (4000)
- Demonstrated improved performance of advanced shaped charge warhead loaded with TNAZ for potential application to Longbow and Javelin (1307)
- Demonstrated armor defeat capability of improved, environmentally safe tungsten penetrators (1307)
- Conducted design study for imaging seeker pyrotechnic decoy expendable flare for increased combat survivability of Army aircraft (900)

FY 1995 Planned Program:

- Establish feasible laboratory scale synthesis routes for new insensitive explosives such as nitro imidozole compounds (830)
- Develop high yield synthetic routes for TNAZ explosives (2818)
- Develop high efficiency reinforced concrete defeat mechanisms (2418)
- Develop process and characterize/evaluate mechanical properties of fully dense, tungsten composite (569)
- Demonstrate pilot plant production capability for manufacture of high performance gun propellant (1500)
- Fabricate test hardware of imaging seeker pyrotechnic decoy expendable flare (266)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (20)

FY 1996 Planned Program:

- Demonstrate advanced multi-roled EFP and shaped charge warheads for smart munition and anti-armor missiles (2100)
- Develop pilot lot process technology for TNAZ explosives (815)
- Demonstrate an automated computer code for the design of optimized shaped charge and EFP warheads (2000)
- Demonstrate advanced EFP anti-armor warhead designs and develop concrete defeat mechanism (700)
- Optimize tungsten composite for small caliber testing (550)
- Test Thermoplastic Elastomers (TPE) propellants in advanced tank cartridge and the 155mm Howitzer Unicharge (950)
- Iterate design of imaging seeker decoy flare (464)

FY 1997 Planned Program:

- Demonstrate polynitrocubane synthesis and transition TNAZ for pilot plant processing (2915)

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- Demonstrate a high efficiency lightweight concrete defeating warhead (2886)
- Complete small caliber testing of tungsten composite penetrators and conduct post mortem (734)
- Develop continuous process for processing of thermoplastic elastomer propellants (1244)
- Complete fabrication and conduct static tests of the imaging seeker decoy (509)

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	35665	28163	28247	28464
Appropriated Value	35665	36209		
Adjustments to Appropriated Value	-820			
a. SBIR/STTR decrement (-16)				
b. Reprogrammed out of PE (-804)				
Current President's Budget Submit	34845	36209	23968	24251

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602624A Weapons & Munitions Technology PROJECT AH18

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH18 Artillery & Combat Support Technology	17183	14622	11332	10512	12039	12903	12980	13367	Continuing	Continuing

C. Other Program Funding Summary See Paragraph A for related programs.

D. Schedule Profile The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Artillery & Combat Support Technology, therefore no milestones or events are provided.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602624A Weapons & Munitions Technology — PROJECT: AH19

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH19 Close Combat Weaponry	7864	5274	5057	5451	7888	9083	9597	9790	Continuing	Continuing

C. Other Program Funding Summary See Paragraph A for related programs.

D. Schedule Profile The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Close Combat Weaponry Technology, therefore no milestones or events are provided.

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602624A Weapons & Munitions Technology		PROJECT AH22

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH22 High Explosive Materials	984	7892	0	0	0	0	0	0	0	8876

C. Other Program Funding Summary See Paragraph A for related programs.

D. Schedule Profile The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of High Explosive Material Technology, therefore no milestones or events are provided.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602624A Weapons & Munitions Technology PROJECT AH28

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH28 Munitions Technology	8814	8421	7579	8288	8684	9545	9557	9801	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Munitions Technology, therefore no milestones or events are provided.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602705A Electronics And Electronic Devices — PROJECT: AH94

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH94 Electronics and Electronic Devices	22027	24004	17525	17555	19020	19932	22739	24207	Continuing	Continuing

A. **Mission Description and Budget Item Justification**: This program consists of research in the physical sciences essential to all land combat systems that contain electronics, chem/bio sensors, photonics, magnetic materials, ferroelectrics, microwave and millimeter-wave components, batteries, and fuel cells. Supported systems include the Future Soldier System (FSS), autonomous missile systems, advanced land combat vehicles, brilliant anti-tank munitions, electric weapons, secure jam-resistant communication, Automatic Target Recognition (ATR), foliage-penetrating radar, Combat Identification, and digitizing of the battlefield. The work under this program element provides enabling capability to perform precision deep fires against critical mobile and fixed targets, to provide exceptional all-weather, day or night, theater air defense against advanced enemy missiles and aircraft, and to develop small, low-cost, lightweight, high-energy sources of power for communications, target acquisition, miniaturized displays and microclimate cooling for Future Soldier System. Under Defense Reliance agreements this program supports the in-house exploratory development effort at a single Army site which serves as both the center for display technology development and the center for frequency control and timing for the Army, Navy, Air Force, Ballistic Missile Defense Organization, and Defense Nuclear Agency. It supports Science and Technology Thrust areas that employ electronic and portable power-source technology. This project includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2.

Project AH94 - Electronics and Electronic Devices: This project provides exploratory development in the application of the physical sciences of physics, electrochemistry, biotechnology, electronics, and process science, as they apply to improving existing systems and enabling newer, more advanced systems. Technology developments support thrusts aimed at reduced acquisition cost, reduced operations and support costs, Army Modernization, Advanced Technology Demonstrations and Advanced Technology Transition Demonstrations, described in the Army Science and Technology Master Plan.

FY 1994 Accomplishments:

- Developed materials, processes, and fabrication technology for passive/active matrix, full color, high-resolution flat panel displays and interactive devices crucial to digitized battlefield and 21 Century Land Warrior. (990)
- Investigated failure of high frequency microcircuits, determined reliability limitations of advanced packaging technology, and established procurement guidance for use of commercial plastic parts to reduce costs. (1275)
- Developed Computer-Aided Design (CAD)/simulation tools for design of digital/analog components from behavioral descriptions for rapid prototyping, acquisition, and improved affordability. Demonstrated advanced packaging and high-power microwave protection. (3200)
- Exploited novel electronic materials and processing technologies to demonstrate high-power photoconductive switches for Ultra Wide Band (UWB) radar and advanced, microscale sensors and actuators for target recognition and engine failure prognosis. (3625)
- Improved primary/rechargeable lithium batteries to increase energy density for man-portable Command, Control, Communications, & Intelligence (C3I). Investigated preliminary fuel cell system design and liquid fuels to enhance survivability and lethality of the dismounted soldier. (3475)

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602705A Electronics And Electronic Devices — PROJECT: AH94

- Designed Microwave (MW) / Millimeter Wave (MMW) and acoustic devices for high data rate communications and extended EW (Electronic Warfare)/radar capabilities. Exploited MW/optical and quasi-optical phenomena to enable advanced imaging systems. (4375)
- Demonstrated 1000 line/inch head-mounted personal viewer. Transitioned to Army Communications Electronics Command low-power, ruggedized display technology for portable and command post C3I systems and the Lightweight Computer Unit (LCU). (700)
- Developed solid state switch modules for power conditioning circuits for Electric Gun and advanced land combat vehicles. Developed narrow band high-power MW sources for MW weapons, radar, and electric gun technology. (397)
- Demonstrated and transitioned to Army Communications-Electronics Command MW transponder for dismounted soldier combat identification; demonstrated one watt, 35/44 Ghz heterojunction bipolar transistor (HBT) power amplifier for smart munitions. (990)
- Executed Congressional special interest program for low-cost, reusable alkaline manganese batteries for portable manpack radios, no-lead added alkaline cells, and advanced non-metallic rechargeable battery systems. (3000)

FY 1995 Planned Program:

- Develop and characterize advanced high performance, full-color display technology and associated technology for interactive displays. (1800)
- Develop and apply techniques and tools to assure cost effective, testable and reliable electronic components. Develop documentation to enable effective insertion of best commercial practice parts. (1575)
- Develop ultra-low power, ultra-high speed microcircuits, e.g. single chip direct digital synthesizer technology. Establish interoperability criteria to achieve rapid insertion and exploit hardware among Army, Navy, and Air Force. (2665)
- Fabricate improved fluidic amplifier, demonstrate micromachined Infra-Red scene generator and improved processing technology for advanced miniature sensors and actuators for mine detection, optoelectronic biosensors and missile seekers. (2360)
- Develop advanced heterojunction devices and integrated circuits, quasi-optical grid oscillators and power combiners, MMW Passive Imaging Arrays, and predictable conformal electronic scan antenna seekers. (5520)
- Develop hydrogen fuel cell for future soldier applications, improved primary lithium battery with 600W-Hr/Kg and rechargeable/polymer cells with 250W-Hr/Kg for soldier, C3I and robotics applications, and pulse power battery with 300Kj/Kg. (4640)
- Demonstrate concurrent computer-aided engineering system with modeling/assessment capabilities for improved affordability, testability, and performance of microcircuits to capitalize on industry foundry processes. (3303)
- Demonstrate rechargeable/polymer cells for soldier, C3I, and robotic vehicles with 140W-Hr/Kg. (1455)
- Demonstrate prototype high sensitivity surface transverse wave (STW) chemical biological sensor. (447)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (239)

FY 1996 Planned Program:

- Demonstrate an electronic component design tool featuring a behavioral accelerator for architectural assessment/optimization, integrate MW/analog/digital design tools into a single Hardware Descriptive Language (HDL), and demonstrate module-to-module High Power Microwave (HPM) protective packaging. (2570)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602705A Electronics And Electronic Devices
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- Design and fabricate advanced MW/MMW components to enable line-of-sight space and terrestrial communications, fire control, and Moving Target Indicator (MTI) radar. Develop sub-MMW/terahertz components to enable communication devices to operate at frequencies where detection, interference, and countermeasures are inhibited. (4130)
- Design and fabricate new oscillator technologies based on micromachined silicon, quartz, and piezoelectric thin-film resonators as well as new piezoelectric materials such as langasite and lithium tetraborate for components for Army land combat command and control situations. (1670)
- Exploit improved processing technologies to fabricate miniature sensors/actuators for mine detection, hand-held optoelectronic biosensors, and missile seekers. (1680)
- Fabricate monolithic infrared detector arrays for anti-tank missiles, tank driver's thermal viewers, and helicopter pilotage and tracking systems. (1525)
- Improve fabrication processes based on phosphor physics and luminescence properties to develop and demonstrate ruggedized, high resolution, low power, flat panel displays for command post situations, personnel communications, and training applications. (1560)
- Develop primary and rechargeable lithium batteries with exceptionally high energy densities for C4I, investigate lithium batteries using high conductivity solid and liquid electrolytes to provide full operation over the military temperature range, and develop fuel cell technologies for microclimate cooling for the 21st Century Land Warrior (21 CLW). (1655)
- Expand surface transverse wave (STW) chemical/biological sensor capability to enable multitoxin sensor array and to interface with the Multiple Integrated Chemical Agent Detector (MICAD). (305)
- Demonstrate 250-Watt portable fuel cell for 21 CLW, prototype low-cost rechargeable alkaline-zinc battery packs for medium rate electronics applications, and demonstrate proof-of-principle maximum energy density battery for 21 CLW. (1820)
- Establish program to assess the long-term failure mechanisms from the use of water based fluxes and cleaners and analyze results of failure diagnostics of plastic encapsulated modules. (610)

FY 1997 Planned Program:

- Develop and apply integrated computer aided design technologies to achieve a 4x reduction in time and cost to develop/upgrade high performance devices, components, and sensor and processor modules for Army land combat systems. (2315)
- Design and fabricate advanced MW/MMW/quasi-optical components to improve line-of-sight space and terrestrial communication, fire control, and MTI radar. Develop sub-MMW/terahertz components to enable communication devices to operate at frequencies where detection, interference, and countermeasures are inhibited. (3200)
- Design and fabricate brassboard circuit to demonstrate a unique capability to detect narrow (nanosecond) pulsed radar signals, evaluate microresonators for IR detector arrays, and develop precision frequency control devices for Army communication/navigation systems. (2035)
- Design and develop monolithic, multispectral focal plane arrays (FPAs) exhibiting greater on-FPA processing capability and evaluate monolithic IR detectors using molecular beam epitaxy (MBE) films. (1605)
- Design, fabricate, and transition improved miniature sensors/actuators for mine detection, hand-held optoelectronic biosensors, and missile seekers. (2530)
- Apply improved fabrication processes based on phosphor physics and luminescence properties to emerging display technologies and develop and demonstrate ruggedized, high resolution, low power, flat panel displays for command post situations, personal communications, and training applications. (1660)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: February 1995
BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602705A Electronics And Electronic Devices — PROJECT: AH94

- Prototype lithium batteries utilizing highly energetic oxyhalide and transition metal oxide cathode materials; demonstrate proof-of-principal thermophotovoltaic power source for quiet mobile electric power field generators. (2605)
- Perform research on reliability, testability, and diagnostics of advanced technology devices and modules for Army land combat vehicle and weapons systems. (605) Jointly evaluate with Air Force high temperature super conducting (HTSC) antenna feed for Military Strategic Tactical Relay System (MILSTAR) and demonstrate and integrate MMW transceiver devices into MTI radar. (1000)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	24886	21222	17773	17423
Appropriated Value	24886	24004		
Adjustments to Appropriated Value	-2859			
a. SBIR/STTR decrement (-239)				
b. Reprogramming (-2620)				
Current President's Budget Submit	22027	24004	17525	17555

C. Other Program Funding Summary: N/A

D. Schedule Profile: The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Electronics Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602709A Night Vision Technology

PROJECT: DH95

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DH95 Night Vision and Electro-Optic Technology	18852	19326	17086	17175	18071	19457	19552	20057	Continuing	Continuing

A. Mission Description and Budget Item Justification: The key objectives of this program are to provide electro-optical technology for devices which can acquire and track enemy targets at the maximum weapons systems ranges under varying conditions of illumination (day/night), obscurity (e.g., smoke) and countermeasure effects, and validating camouflage techniques for denying acquisition or detection by the enemy. Development is concentrated on infrared Focal Plane Arrays (FPAs), advanced optics, low energy lasers, advanced Aided Target Recognition (ATR), low-cost, low-observable multispectral technology and performance modeling, simulation and analysis for supporting systems development. This program element supports all major weapons systems as well as the Joint Precision Strike Demo (JPSD) and Rapid Force Projection Initiative (RFPI) advanced concept technology demonstrations (ACTDs), and the 21st Century Land Warrior (CLW) integrated technology program. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and adheres to Tri Service Reliance Agreements on Sensors and Electronic Devices with oversight and coordination provided by the Joint Directors of Laboratories. This work is related to and fully coordinated with efforts in the following program elements: PE 0602786A/AH20, Countermine/Low-Cost, Low-Observable; PE 0603710A, Night Vision Advanced Technology. This project includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2. This program is primarily managed by Communications-Electronics Command Research, Development and Engineering Center, Fort Monmouth, NJ.

Project DH95 - Night Vision and Electro-Optics Technology: In thermal imaging, emphasis is on development of technologies needed for a new generation of high density FPAs to significantly increase the sensitivity of Forward Looking Infrared (FLIR) systems to meet stringent target acquisition requirements of future weapon systems and future sensor concepts to upgrade current Army assets for advanced targeting and autonomous recognition. In advanced optics, the emphasis is on the development and demonstration of a family of core optics and display technologies for future head-mounted vision systems that will be utilized by 21CLW, Mounted Warrior, 2nd generation (gen) FLIR Horizontal Technology Integration, the Advanced Image Intensification advanced technology demonstration (ATD), Comanche, and the Advanced Helicopter Pilotage technology demonstration. In lasers, emphasis is on the development of modular laser technology for Army tactical laser countermeasures, obstacle avoidance, biological agent detection, rangefinding, enhanced target recognition and laser radar for integration with vehicle target acquisition sensors. This technology development supports the Target Acquisition, Hunter Sensor Suite, and Battlefield Combat Identification technology demonstrations, and ground vehicle survivability systems. In signal processing, emphasis is on the exploitation of advanced ATR processing prototypes and implementation of near-real-time processing of target acquisition data from multiple sensors such as second generation thermal imagers, millimeter wave (MMW) radar and lasers to enhance lethality/survivability of future weapons systems. This high performance processor technology transitions to the Hunter Sensor Suite and Target Acquisition technology demonstrations and other future technology demonstrations. This project involves investigation of technologies that enable the development and evaluation of low-cost, low-observable multispectral systems which conceal friendly force assets from threat sensors and on sensors to acquire enemy low observable targets. It also involves technology development needed for an electronic capability consisting of interactive 3-dimensional (D) (thermal, MMW, Radar) models, sensor simulations and scene generation to evaluate ATR and human performance models. This is critical in evaluation/analysis to determine a baseline performance indicator for weapon system managers producing high-performance, low-cost, electro-optic target acquisition systems.

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602709A Night Vision Technology	PROJECT DH95

FY 1994 Accomplishments:

- Developed advanced thermally-matched readouts to maximize FPA size architectures for applications requiring large area, multispectral staring arrays (4175)
- Developed new optical structures to increase performance envelopes while reducing cost of advanced electro-optical sensor systems (4006)
- Developed high efficiency laser source operating in the visible and near infrared spectral bands using diode array pumped solid state crystalline laser medium (700)
- Mapped Multi-Sensor Aided Targeting (MSAT)-Air ATR algorithms into Aladdin processor and conducted experiments to validate automated targeting concepts (2671)
- Developed the key protocols and interface mechanisms to implement night capability onto the Army simulation node for interactive simulation activities with the Battle Laboratories (2700)
- Demonstrated concept for target detection metric to improve the performance of target acquisition models against low signature targets (700)
- Developed an interactive staring testbed to evaluate and assess staring focal plane arrays and improvement methodology (3900)

FY 1995 Planned Program:

- Demonstrate initial thermal scene rendering capability for virtual imagery and validate 3-dimensional thermal models (2700)
- Demonstrate MSAT-Air ATR algorithm in high-density processor testbed and transition high-performance processor module technology to Hunter Sensor System and Target Acquisition technology demonstrations in PE 0603710A (1800)
- Initiate open system architecture studies and analysis to apply commercial practices and architectures to Aladdin-like multi-chip module processor technology (1935)
- Demonstrate monolithic integration of readout and long-wave length IR (LWIR) detector array and initiate multispectral shared aperture testbed with analog to digital (A/D) on-chip and neural type processing (4360)
- Evaluate state-of-the-art optics technologies such as binary, diffractive and holographic for head-mounted vision system applications (3922)
- Demonstrate high-efficiency diode-pumped laser with diverse wavelength module (visible to near infrared (IR)) and transition to Laser Counter Measure Systems (LCMS), PE 0604710A (700)
- Develop models of low observable targets for incorporation into electronic terrain board simulation system (928)
- Evaluate emerging staring focal plane arrays for imaging applications and establish critical improvements methods (2926)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (55)

FY 1996 Planned Program:

- Complete thermal scene rendering capability for virtual imagery and provide data base for simulated night scene to the Dismounted Battlespace Battle Lab (3200)
- Validate representation of low observable target models in electronic terrain board system (1000)
- Integrate high density multi-chip modules into a commercial processor and demonstrate selected critical ATR algorithm functions (2312)
- Conduct laboratory demonstrations of optical phase oscillator (OPO) techniques to generate multiple wavelengths in the 1-5 micron region for multiple laser applications, and initiate development of multifunctional control software (528)
- Demonstrate initial near-IR (NIR), middle-wave length IR (MWIR), and long-wave length IR (LWIR) detector fusion and fabrication of a multispectral monolithic detector array technology using molecular beam epitaxial (MOMBE) technology (3502)

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602709A Night Vision Technology
	PROJECT: DH95

- Complete advanced designs for objective and ocular optics for 21CLW Helmet Mounted Vision System (HMVS) and demonstrate cost/weight reductions for potential optical system upgrades using binary optics hybrid (3242)
- Continue evaluation of staring focal plane arrays for imaging applications and establish performance metrics and preliminary performance models (3302)

FY 1997 Planned Program:

- Integrate initial version of advanced FPA to high density ATR processor modules (1400)
- Develop core display electronics and sensor technologies from multiple HMVS and fabricate advanced optics components for demonstration in 21CLW HMVS (3300)
- Initiate development of high-throughput optical interconnects and electronic/optical transducers for the processing plane; develop methodology to incorporate the elements of neocognitive recognition in hardware (2185)
- Demonstrate high repetition rate laser module with multiple wavelength output in the 1-5 micron band, integrate laser radar/rangefinder functional software modules, and transition eyesafe multifunction laser to Target Acquisition technology demonstration in PE 0603710A (1241)
- Demonstrate rapid prototyping of processor modules utilizing computer-aided design techniques and commercial/Advanced Research Projects Agency (ARPA) developed tool sets (2096)
- Demonstrate non-realtime multisensor scene rendering (3111)
- Demonstrate passive technologies for suppression of mobile and semi-mobile assets multispectral signatures, reducing detection ranges by 50 percent in woodland, desert, arctic and urban battlefield environments (842)
- Evaluate staring focal plane performance against preliminary model; refine modeling capability and staring focal plane array metrics (3000)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	18917	19406	16882	16970
Appropriated Value	18917	19325		
Adjustments to Appropriated Value	-65			
a. SBIR/STTR (-17)				
b. Reprogramming (-48)				
Current President's Budget Submit	18852	19326	17086	17175

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile: The efforts in this project are non-system specific and represent continuing exploratory development in the area of Night Vision Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602716A Human Factors Engineering Technology

PROJECT: AH70

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH70 Human Factors Engineering Systems Development	15860	14265	12534	15012	16080	15912	15653	16055	Continuing	Continuing

A. Mission Description and Budget Item Justification This program focuses on maximizing the effectiveness of the soldier in concert with his material, in order to survive and prevail on the battlefield. The 21st Century Land Warrior (21CLW) program is directly supported by this soldier-system performance and supportability enhancement program. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of soldiers, with particular attention on soldier and equipment interaction. The resulting data are the basis for weapon systems and equipment design standards, guidelines, handbooks and soldier training and manpower requirements to improve equipment operation and maintenance. Application of advancements yields reduced workload, fewer errors, enhanced soldier protection, user acceptance, and allows the soldier to extract the maximum performance from the equipment. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. All work under this PE is part of the "Human-Systems Interfaces" Tri-Service Reliance panel. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project AH70 - Human Factors Engineering Systems Development

FY 1994 Accomplishments:

- Demonstrated a knowledge-based decision support system that enables interactive planning and scheduling for all classes of supply, typical of the size and complexity of Desert Storm. (923)
- Initiated variable reach rough terrain fork lift (VRRFTL) sensor and automation enhancements and report on field trials. Initiated the investigations of robotic systems with haptic, touch, and force feedback. Completed HARDMAN III modeling for palletized loading system. Integrated the National Institute for Science and Technology Real-Time Control software onto the field material handling system for the user interface. (965)
- Enhanced the auditory detection model (ADM) by developing and incorporating a method for measuring ground impedance and its effects; demonstrated 3-D auditory sound localization. (573)
- Conducted software experiments on brigade staff intelligence decision support system (IDDS) requirements including development of a prototype for demonstration. (1905)
- Demonstrated enhanced virtual reality capabilities for individual soldier simulation, including a mobility platform; initiated integration of JACK model with simulated environment. Incorporated body strength data into the JACK model. Exploited novel input devices to translate user movement into virtual figure behaviors.
- Developed a database to support analyses of the soldier as a system. (2284)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602716A Human Factors Engineering Technology PROJECT AH70

- Developed simulation software to drive soldier resource extremes at force-level; developed simulation software task performance for novel technology; ran initial tests on next generation HARDMAN III. Integrated MANPRINT tools (IMPRINT). Initiated verification and validation of HARDMAN III MANPRINT tools. Prepared HARDMAN III initial accreditation review report. (2065)
- Conducted testing and evaluation of battlefield-hazardous environment simulation facility and evaluated heads-up display for rifle sight. (1790)
- Enhanced MANPRINT field test and evaluation (T&E) methods with soldier-in-the-loop operational test exercises to reduce costs and timeliness burden to Test and Evaluation Experiments Command. (1177)
- Obtained data to form parameters of MANPRINT models while providing MANPRINT evaluation and design support to Training and Doctrine Command (TRADOC), Army Materiel Command (AMC), BattleLabs, Research, Development and Engineering Centers (RDECs), and laboratories. (3587)
- Incorporated modifications, and submitted for publication the draft MIL-STD-1477C, Symbols for Army Systems. Initiated human factors research on the symbology proposed in draft MIL-STD-2525, Common Warfighting Symbology, and coordinated with the Defense Information Systems Agency (DISA). (116)
- Completed demo of VIP/GPS for artillery application. (475)

FY 1995 Planned Program:

- Complete Knowledge-based Logistics Planning Shell (KBLPS) Style Guide, including domain definition, conceptual design, and design requirements for all major KBLPS components with justifications derived from user studies. Complete an operational prototype of map-based user interface management system. (209)
- Complete integration of mobile manipulator platform control. Complete VRRTFL sensor and automation enhancements for pallet acquisition. Demonstrate robotic manipulators with force and tactile sensors and investigate time-delay and reduced bandwidth communication. Develop a robotic workcell to research automated materials handling, including hazardous environments. (1333)
- Expand use of auditory detection model to include predictions for impulse noise, and demonstrate operator guidance with 3-D auditory display, including development of speech intelligibility measures for possible insertion to future individual soldier equipment ensembles. (826)
- Complete experiments on aids for collaborative decision making with a force "on the move". (1175)
- Complete mobility platform, and integrate with upper body sensor suit and helmet mounted display. Continue integration with enhanced JACK model. Improve distributed interactive simulation system compatibility. Develop integrated task network models, using the JACK model. Develop natural language instruction and complete enhancement of the JACK model. (1939)
- Prepare HARDMAN III incremental review report. Develop integrated MANPRINT tools (IMPRINT), version 1.0, with initial analysis capability. (1331)
- Exercise battlefield-hazardous environment simulator with fielded and prototype systems to develop calibration procedures, data collection procedure, and a standard operating procedure (SOP) for human use. (1848)
- Enhance MANPRINT field T&E methods with soldier-in-the-loop operational test exercise data to upgrade Test and Evaluation Experiments Command capabilities to assess new-technology systems. (5019)
- Derive field, laboratory, and simulation exercise data to form parameters for MANPRINT evaluation and design support to TRADOC, AMC, BattleLabs, RDECs, and laboratories. (148)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602716A Human Factors Engineering Technology PROJECT AH70

- Complete evaluations of proposed symbology for MIL-STD-2525 (Common Warfighting Symbology), and analyze results; present results to the Defense Information Systems Agency (DISA). (200)
- Complete transition of VIP/GPS technology to ARDEC. (167)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (70)

FY 1996 Planned Program:

- Develop operational prototype of information exploration tool, including operational prototype of the management of the multitude of assumptions made by the user (ASSUMPTION MANAGER), and interactive logistics planning prototype with automated graphics generation. (231)
- Collect performance data on sensor-human feedback interface devices, exoskeleton control devices for human positioning and monitoring and multi degree of freedom force sensors. Complete advanced armored vehicle technology (AAVT) study on armor vehicle containerization. Continue the palletized loading system container lift kit study. (1040)
- Improve the auditory detection model (ADM) through localization and impulse noise detection. (500)
- Conduct Performance Research to evaluate advanced controls and displays for a force "on the move" in adverse environments. (1788)
- Enhance virtual reality system with state-of-art technology, as necessary, including enhancement of JACK model to act as intelligent semi-automated forces in distributed interactive simulations and implementation of the improved real-time body collision avoidance algorithms for the human figure performance model. (1826)
- Develop integrated MANPRINT tools (IMPRINT), version 1.0, accreditation review report. Develop integrated MANPRINT tools (IMPRINT), version 2.0, with full-scale analysis and process-linked capability. Develop trade-off tool in integrated MANPRINT tools (IMPRINT), to assess effects of available manpower and personnel characteristics on system redesign options. (824)
- Integrate hostile environment simulator with individual soldier's portal (I-PORT). (2260)
- Complete the Light Helicopter/RAH-66 Comanche force development test and experimentation II, and validate MANPRINT tools for evaluation of new systems. (3752)
- Provide MANPRINT and human factors engineering (HFE) support to AMC, AMC RDEC installations, Training and Doctrine Command (TRADOC), battle labs and laboratories. (106)
- Continue research support for the Defense Information Systems Agency (DISA) in the development of Draft MIL-STD-2525, Common Warfighting Symbology, as required. (207)

FY 1997 Planned Program:

- Produce future operations style guide for all major KBLPS components, with justifications derived from user studies. (458)
- Develop forklift enhancement data on International Standard Organization (ISO) container unstuffing to validate operator interface improvements. Investigate control and operator sensing strategies and configurations for teleoperated manipulator devices doing military tasks. Complete development and evaluation of the automated field material handling workcell concept. (1372)
- Incorporate auditory performance parameters into metrics to enhance soldier survivability. (593)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602716A Human Factors Engineering Technology PROJECT AH70

- Conduct simulations in a distributed interactive simulation (DIS) environment for decision making by a dispersed force. (2222)
- Apply virtual reality system to concurrent engineering problems such as component development and component integration. Apply virtual reality system to mission rehearsal issues, allowing multiple player interaction. Complete development of body smoothing algorithms for the human figure performance model. (2164)
- Perform unit design, including leadership, C2, and support effects, and complete integrated MANPRINT tools (IMPRINT), version 2.0 accreditation review report. (1003)
- Integrate hostile environment simulator with the battlefield distributed simulation system. (1993)
- Support the battle command vehicle (BCV) initial operational test and evaluation and validate MANPRINT tools for evaluation of new system. (4696)
- Provide MANPRINT and HFE support to AMC, AMC RDEC installations, Training and Doctrine Command (TRADOC), battle labs and laboratories. (260)
- Complete and publish MIL-STD-2525, Common Warfighting Symbology. (251)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	15144	14393	13928	14896
Appropriated Value	15144	14265		
Adjustments to Appropriated Value	716			
a. SBIR/STTR decrement (-65)				
b. Reprogramming (+781)				
Current President's Budget Submit	15860	14265	12534	15012

C. Other Program Funding Summary N/A

D. Schedule Profile The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Human Factors Engineering Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602720A Environmental Quality Tech

	COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	53093	45663	21304	24164	27113	35587	34268	33931	Continuing	Continuing
D048	Industrial Operations Pollution Control Technology	3327	3384	1539	2083	2257	2499	2494	2559	Continuing	Continuing
A821	Bioremediation Education, Science and Technology (BEST) Centers	1969	0	0	0	0	0	0	0	0	1969
A822	Facility Environmental Management and Monitoring System (FEMMS)	4430	4933	0	0	0	0	0	0	0	9363
A823	Hawaii Small Business Development Center	5316	5327	0	0	0	0	0	0	0	10643
A824	National Renewable Energy Laboratory (NREL)	984	0	0	0	0	0	0	0	0	984
A826	Unexploded Ordance Remediation	9845	4933	0	0	1900	9020	7901	6576	Continuing	Continuing
A829	National Defense Center for Environmental Excellence (NDCEE) Technology	9594	8936	13196	12690	12934	12960	13006	13648	Continuing	Continuing
A830	Biodegradable Packaging Technology	4922	4440	0	0	0	0	0	0	0	9362
A833	Saltsburg Remediation Technologies	0	986	0	0	0	0	0	0	0	986
A835	Military Medical Environmental Criteria	4281	4166	2240	3263	3532	3948	3950	4053	Continuing	Continuing
A896	Base Facility Environmental Quality	4715	4583	2491	3422	3771	4112	3865	3964	Continuing	Continuing
AF25	Military Environmental Restoration Technology	3710	3975	1838	2706	2719	3048	3052	3131	Continuing	Continuing

A. Mission Description and Budget Item Justification This Program Element (PE) provides technology that allows the Army to comply with regulations mandated by all Federal, State and local environmental/health laws and to reduce the cost of this compliance. Examples of key laws include the Superfund Amendments and Reauthorization Act of 1986 and the Defense Environmental Restoration Act (the DoD equivalent of this law), in addition to the Resource Conservation and Recovery Act of 1984, as amended. This PE provides the Army with a capability to decontaminate or neutralize Army-unique hazardous and toxic wastes at sites containing waste ammunition, explosives, heavy metals, propellants, smokes, chemical munitions, and other organic contaminants. The current DoD estimate for the total Army cost of

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completing this cleanup program is 8 to 10 billion dollars. This PE also provides technology to avoid the potential for future hazardous waste problems, by reducing hazardous waste generation through process modification and control, materials recycling and substitution. This PE develops pollution control technology which assists installations to comply with environmental regulations at less cost. The PE also provides technology to mitigate noise impacts and maneuver area damage resulting from Army training activities. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on Civil Engineering and Environmental Quality with oversight provided by the Joint Engineers and Armed Services Biomedical Research Evaluation and Management. These projects include non-system specific development efforts directed at specific military needs and therefore are appropriate to Budget Activity 2.

Project D048 - Industrial Operations Pollution Control Technology: This project provides pollution control technologies required to reduce the cost of treating hazardous toxic effluent from operation of Army industrial installations which include ammunition plants, depots, arsenals, and to satisfy increasingly stringent wastewater discharge standards under the Clean Water Act and relevant state regulations. Federal facilities are now subject to fines and facility shutdowns for violation of Federal, State, and Local air and wastewater discharge regulations. This new technology is essential to control and reduce generation of hazardous waste and in order to satisfy hazardous waste reduction goals and to avoid future hazardous waste disposal costs and liabilities to the Army. This project will provide compliance tools to control toxic air pollutants regulated under the Clean Air Act Amendments. The primary developing agency is the US Army Construction Engineering Research Laboratories, Champaign, IL.

FY 1994 Accomplishments:

- Developed operational and analytical protocol for on-site pilot scale testing of dinitrotoluene (DNT) destruction and identified trace level organics in pilot redwater wet air oxidation effluents (2591)
- Conducted pilot scale test of hydromills for processing energetic material prior to destruction (736)

FY 1995 Planned Program:

- Develop open burning/open detonation alternatives technology, transfer to field and assist with implementation (382)
- Develop computer model for simulations of advanced oxidation processes effectiveness based on physiochemical properties of wastewater (2359)
- Complete development of treatment technology for nitrocellulose fines and prepare for demonstration (579)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (64)

FY 1996 Planned Program:

- Develop technology for nitrocellulose fines capture and treatment (751)
- Develop preliminary guidance on air toxics from plating operations (380)
- Develop guidance for stabilizing blast grit dust containing metals (120)
- Develop volatile organic compound (VOC) treatment technology for multibase propellant production (288)

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FY 1997 Planned Program:

- Develop guidance for stabilizing heavy-metal bearing treatment residues (253)
- Develop preliminary guidance on pyrolytic behavior of energetic materials (680)
- Develop guidelines for application of advanced oxidation processes for munitions wastes (380)
- Acquire preliminary data for use of propellant as a fuel source (770)

Project A821 - Bioremediation Education, Science and Technology Centers (BEST): This Congressionally mandated project is managed by the Army to develop a partnership of a major research university, a national laboratory, and a science consortium located at a historically black college or university (HBCU) to advance the field of bioremediation research to support Army environmental quality technology development for environmental restoration and waste management.

FY 1994 Accomplishments:

- Scope of program identified, concept paper drafted and Broad Agency Announcement prepared to implement a university, national laboratory, and HBCU consortium partnership and development for bioremediation research and demonstration on environmentally hazardous wastes in FY 95. (1969)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A822 - Facility Environmental Management and Monitoring System (FEMMS): This Congressionally mandated project is managed by the Army to develop the initial phase of a demonstration testbed at Tobyhanna Army Depot for the integrated and comprehensive management and control of environmental emissions and wastes and other issues.

FY 1994 Accomplishments:

- Demonstrate an environmental monitoring management and control system testbed in coordination with the National Defense Center for Environmental Excellence (NDCEE) (to be completed FY 1995) (4430)

FY 1995 Planned Program:

- Install and validate demonstration of environmental monitoring and management system (4829)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (104)

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FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A823 - Hawaii Small Business Development Center: This project was added by the Congress. It is a continuation of an effort begun and funded in FY 93 under project A830. The project has technology policy goals favoring activities that meet dual-use and employment-creating criteria. The former refers to commercializing products that are used by armed services personnel as well as the civilian population. The latter is offered as a contribution to US economic revitalization. The basic approach being followed involves private-public partnerships to carry out activities leading to the commercialization of these products. Advisory personnel from Federal agencies (primarily the Departments of Defense and Agriculture) and State agencies participate at the work group level and oversight committee levels.

FY 1994 Accomplishments:
- Developed agriculture-industrial products having potential for dual use and commercialization.; continued investigation of twenty U.S. produced medicinal/herbal plants and product derivatives that can only be grown in Hawaii (5316)

FY 1995 Planned Program:
- Commercialize products previously developed using the private-public partnership operating through the Agribusiness Development Corporation (5215)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (112)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A824 - National Renewable Energy Laboratory (NREL): This project has been designated Congressional special interest, for the purpose of accelerating environmental activities for solar detoxification of hazardous wastes. This project is carried out at the National Renewable Energy Laboratory (NREL) and managed by the Department of Energy's Office of Industrial Technologies (OIT). The mission is to develop solar-based technologies as cost-effective alternatives to conventional technologies for the treatment of hazardous wastes in water, air, and soil. The technology uses ultraviolet light from sunlight to decompose hazardous organic compounds or remove heavy metals from contaminated sites or process streams. NREL will apply current research to areas of immediate interest to the DoD. The ul imate goal of this work is to provide sufficient information to enable industry to construct full-scale systems for site remediation or hazardous waste treatment at applicable DoD sites. This project will leverage DoE funds designated for solar detoxification and will be closely coordinated with DoD.

FY 1994 Accomplishments:
- Finalize Memorandum of Agreement with DoE (to be completed FY 1995) (21)
- Conduct research on process improvements to improve performance of solar detoxification technology (to be completed FY 1995) (313)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602720A Environmental Quality Tech

- Conduct and make operational the demonstration system at selected site and evaluate operation of demonstration system and report findings (to be completed FY 1995) (500)
- Evaluate operation of demonstration system and report findings (to be completed FY 1995) (150)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A826 - Unexploded Ordnance Removal: *This project has been designated Congressional special interest. The purpose of the project is to conduct a* demonstration of commercially available technology to detect and remediate unexploded ordnance (UXO) at Jefferson Proving Ground (JPG). The project is managed by the US Army Environmental Center, Aberdeen Proving Ground, MD.

FY 1994 Accomplishments:
- Planned and conducted JPG live site UXO demonstrations of emerging commercial technologies (7045)
- Developed four additional live demonstration sites (1400)
- Conducted second phase of advanced technology demonstrations (1400)

FY 1995 Planned Program:
- Plan and conduct second phase of advanced UXO technology demonstrations at JPG (4000)
- Incorporate technology enhancements into prototype UXO detection system (829)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (104)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A829 - National Defense Center for Environmental Excellence (NDCEE) Technology: This Congressionally mandated project is managed by the Army on behalf of the Office of the Deputy Undersecretary of Defense for Environmental Security (DUSD-ES). The mission of the NDCEE is three-fold: (1) Demonstrate and export new environmentally-acceptable technology to the industrial base; (2) train the industrial base on the use of the new technology; and (3) perform research and development, where necessary, to mature a new technology prior to demonstrating and exporting the new technology to the industrial base. The NDCEE, which is located in Johnstown, Pennsylvania, has a principle goal of resolving the environmental technology requirements of the DoD community and commercial industrial base. The

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NDCEE is to evaluate alternative manufacturing materials, treatments and processes which comply with environmental and OSHA regulations. The primary in-house development agency is the U.S. Army Materiel Command's Armament Research, Development, and Engineering (RDE) Center, Picatinny Arsenal, NJ.

FY 1994 Accomplishments:

- Established and expanded operation of environmental technology facility, environmental information analysis system, industrial outreach programs, and multi-service environmental and industrial operations support (5157)
- Initiated five Congressionally directed efforts (plastic sortation, risk assessments, coal cleaning, medical waste tracking, and Adams process investigation) (3815)
- Began planning for Congressionally directed projects, to include assessment of strategic coal reserves, disposal of used torpedo boilers, nitrogen removal (patented process known as NitRem) demonstration, phosphoric acid fuel cell demonstration, and biological approaches to remediation and pollution prevention (622)

FY 1995 Planned Program:

- Maintain/upgrade environmental technology facility, industrial base integration and environmental analysis (4285)
- Continue execution of Congressionally directed efforts: plastic sortation, industrial health risk assessments, coal cleaning and medical waste tracking, phosphoric acid fuel cell investigation, NitRem removal process demonstration, Adams process investigation, biological approaches to remediation and pollution prevention, and assessment of strategic coal reserves (3879)
- Provide technology transfer and transition of DOD efforts, including Non-Halogenated metal parts cleaning, electrodeposited coatings, powder coating demonstration, non-chrome conversion coatings, and waterjet paint stripping (417)
- Provide in-house funds for Crane Naval Warfare Center for energetic material processing and support (167)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (188)

FY 1996 Planned Program:

- Continue operation of environmental technology facility, environmental information analysis system, industrial outreach programs and multi-service environmental and industrial operations support (7262)
- Begin new DoD developed efforts and continue existing projects (including plastic sortation, risk assessments, coal cleaning, medical waste tracking, Adams process investigation, assessment of strategic coal reserves, disposal of used torpedo boilers, nitrogen removal demonstration, phosphoric acid fuel cell demonstration, and biological approaches to remediation and pollution prevention (5934)

FY 1997 Planned Program:

- Maintain operation of environmental technology facility, environmental information network, industrial outreach programs and multi-service environmental and industrial operations support (8413)
- Continue Congressionally directed projects (including plastic sortation, risk assessments, coal cleaning, medical waste tracking, Adams process investigation, assessment of strategic coal reserves, disposal of used torpedo boilers, nitrogen removal demonstration, phosphoric acid fuel cell demonstration, and biological approaches to remediation and pollution prevention (4277)

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Project A830 - Biodegradable Packaging Technology: This project is a joint DoD, Department of Agriculture (DoA) and industry program to commercialize biodegradable polymers for packaging applications and develop advanced materials of military interest from renewable resources. The project has been designated Congressional special interest. The program addresses agricultural-based and other technologies to support material needs for the four Military Services, Special Operations Command, and the Defense Logistics Agency. Thrust areas include research and development of biodegradable packaging materials as replacements for existing packaging to enhance disposability, reduce signature in the field, meet environmental requirements, meet international treaty obligations, and lighten the load for the individual soldier through advanced fibers and composites from renewable resources. The primary developing agency is the U. S. Army Natick Research, Development and Engineering (RDE) Center, Natick, MA. The work is performed through the Department of Agriculture, Cooperative State Research Service located in Washington, DC, through contracts with University of Massachusetts, Tulane University, Illinois Institute of Technology, Lebensmittel, Inc. of Fostoria, Ohio, and Woods Hole Oceanographic Institute.

FY 1994 Accomplishments:

- Developed advanced materials including biocomposites, chemical enzymatic reactive agents, genetically engineered silk, biodiesel fuels, guayule rubber and agricultural-based coatings and foams for Army use (4500)
- Awarded a new joint patent for biodegradable packaging/products, which describes starch blended with a cellulose derivative to be used for bags and utensils to Army (Natick RDE Center) and an industrial partner, (422)

FY 1995 Planned Program:

- Develop advanced materials, such as new ceramics from biometrics, enzymatically active substrates, and high strength fibers from the expression of silk genes in tobacco and soy plant cells (3647)
- Conduct Army field evaluations of agriculturally derived products, such as packing materials, bioderived fluids, peelable coating, and energy absorbing foams (300)
- Demonstrate biodegradable coatings for paper products to be applied to new biodegradable hot drink cups (200)
- Develop enzymatically active adsorbents for use in waster removal in streams; pursue soil remediation via new genetically engineered root plant technology (200)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (93)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A833 - Saltsburg Remediation Technology: This project, which was added by Congress, investigates the feasibility of existing technologies for the intact removal of buried drums containing potentially hazardous materials at a site near Saltsburg, Pennsylvania. A contractor, Federal Laboratories, operated a facility here to manufacture munitions prior to the 1970's. The project will be performed by the Army Corps of Engineers Waterways Experiment Station.

FY 1994 Accomplishments: Project not funded

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FY 1995 Planned Program:

- Conduct investigations to determine feasibility of existing technologies for intact removal of buried drums containing potentially hazardous materials at a site near Saltsburg, Pennsylvania. (965)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (21)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A835 - Military Medical Environmental Criteria: This project evaluates human health and environmental effects resulting from exposure to explosives, propellants, and smokes produced in Army industrial and field operations or disposed of through past activities. The end results of this research are determinations of acceptable residual concentration levels that will protect human health and the environment from adverse effects. The products of this research are U.S. Environmental Protection Agency approved health advisories and criteria documents that specify which Army compounds are toxic/hazardous and the appropriate cleanup or discharge levels. 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 laboratory is the Biomedical Research and Development Laboratory, Ft. Detrick, MD and the Center for Health Promotion and Preventive Medicine.

FY 1994 Accomplishments:

- Configured an acute aquatic toxicity module and preliminary carcinogenicity model for mobile biomonitoring facility (1638)
- Validated developmental toxicity model and on-site validation of field chemical module (380)
- Developed and validated air dispersion fate models (1100)
- Developed and validated methods to predict uptake of contaminants by plants (380)
- Produced health advisories and criteria for Army inventory chemicals (273)
- Conducted hazard assessment of byproducts of munitions-contaminated soils incineration (510)

FY 1995 Planned Program:

- Construct mammalian models for carcinogenicity using non-mammalian aquatic species and non-mammalian models (1461)
- Validate combined field biomonitoring methods for acute toxicity, developmental toxicity, and carcinogenicity (1140)
- Develop microbial fate models and biomarkers of exposure (312)
- Produce health advisories and criteria for Army inventory chemicals (90)
- Develop methods for ecological health advisories (160)
- Conduct hazard assessment of byproducts of munitions-contaminated soils incineration and from bioremediation of contaminated groundwater (486)
- Develop models/methods to predict effect on humans from exposure to contaminated soils and water, ecological effects, and structure/activity relationships (430)

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- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (87)

FY 1996 Planned Program:

- Construct mammalian immunotoxicity and reproductive toxicity models using aquatic species (982)
- Develop and validate microbial fate models and biomarkers of exposure (372)
- Produce health advisories and criteria for Army inventory chemicals (163)
- Develop methods for ecological health advisories (140)
- Conduct hazard assessment of byproducts of munitions-contaminated soils and groundwater (348)
- Develop models/methods to predict effect on humans from exposure to contaminated soils and water (235)

FY 1997 Planned Program:

- Develop ecological risk/hazard assessment model (517)
- Develop models/methods to predict effect on humans from exposure to contaminated soils and water (565)
- Develop environmental fate surface run-off model, validate environmental transport model (484)
- Conduct hazard assessment of munitions byproducts from contaminated soils and groundwater (862)
- Develop and validate non-mammalian immunotoxicity and reproductive toxicity assays (835)

Project A896 - Base Facility Environmental Quality: This project provides Army the technical capability to preserve and improve the physical and biological characteristics of fixed installation training and testing areas in conjunction with sustainment of mission requirements while conserving natural resources, including threatened and endangered species. Efforts under this project will also enable the Army to address compliance with the myriad Federal, state and host country environmental regulations dealing with hazardous and non-hazardous water, wastewater, emissions, solid wastes (including sediment discharges), and noise. An additional effort involves the development of environmental monitoring and modeling capabilities to support both conservation and compliance programs. The primary developing agency is the U.S. Army Construction Engineering Research Laboratories, Champaign, IL.

FY 1994 Accomplishments:

- Developed standardized data collection for training land condition assessment and erosion control technologies (1273)
- Developed implementation package for best management practices for stormwater control (1016)
- Developed advanced technology for air pollutant emissions management for Army installations (583)
- Developed visualization and time series tools for digital elevation in watershed models (1218)
- Developed tools and systems allowing environmental planners and managers to project the consequences of several concurrent projects or actions including update of the Economic Impact Forecast System (625)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602720A Environmental Quality Tech

FY 1995 Planned Program:

- Assess air and soil impacts of conventional lead-based paint removal technologies (187)
- Develop automated capability to report the status of threatened and endangered species (515)
- Develop prototype knowledge-based system for air pollution compliance strategies for Army operations (824)
- Construct integrated framework for spatial and aspatial data translation and analysis (340)
- Develop software for extrapolation of ecological data over large areas using remote imagery (134)
- Develop definable units for natural resources carrying capacity (1507)
- Develop methodologies for integrating installation environmental carrying capacity (261)
- Complete revision of blast noise model (815)

FY 1996 Planned Program:

- Develop automated system for selecting re-vegetation plant species (466)
- Develop threatened and endangered species (TES) inventory and monitoring protocols (606)
- Develop guidelines for mitigating environmental impacts of lead-based paint removal (973)
- Complete evaluation of emerging technologies for advanced sanitary wastewater treatment at Army installations (446)

FY 1997 Planned Program:

- Develop validated risk assessment models to determine the effects of Army activities on threatened and endangered species (550)
- Develop land-based carrying capacity model (719)
- Develop guidance for small arms range noise mitigation (755)
- Develop prototype systems interface for delivery of environmental information for training land management decisions (708)
- Prepare enhanced air compliance management system for demonstration (690)

Project AF25 - Military Environmental Restoration Technology: This project provides cost effective technologies required to clean up DoD hazardous waste sites, including those installations on the Environmental Protection Agency National Priority List and those indicated for closure under DoD Base Realignment and Closure Program. The primary thrust of this effort is to expedite site cleanup, reduce the cost of cleanup of contaminated soil, groundwater, and structures, and to ensure that human health and the environment are protected. Research is conducted in three major areas: innovative and cost effective site identification, characterization, and monitoring technologies; groundwater modeling 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. The primary developing agency is the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

FY 1994 Accomplishments

- Developed enhanced sensors and sampling devices for the Site Characterization and Analysis Penetrometer System (SCAPS) (650)

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- Developed analytical methods for assessing explosives, explosive degradation products, and military-unique compounds in complex environmental media such as compost, slurries, and soils (300)
- Provided design criteria and assessment of in-situ and ex-situ biological processes for remediation of explosives/organics-contaminated soils (2260)
- Developed enhanced contaminant transport algorithms for explosives and military-unique compounds (240)
- Developed methods of assessing metal specification technologies and mass transport limitations on mobility of metals in soils (260)

FY 1995 Planned Program:

- Establish guidance on selecting, designing, and operating biotreatment systems for explosives/organics-contaminated soils and groundwater (2831)
- Configure technical data package and guidance documents on physical separation technologies for metals-contaminated soils (375)
- Determine evaluation techniques for enhanced sensors and sampling devices for SCAPS (169)
- Develop a computer-based DoD Groundwater Modeling System incorporating enhanced contaminant transport algorithms for explosives and military-unique compounds (116)
- Develop analytical methods for assessing explosives, explosive degradation products, and military-unique compounds in complex environmental media such as compost, slurries, and soils (400)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (84)

FY 1996 Planned Program:

- Provide improved analytical methods for hydrazine and field analysis techniques for nitrocellulose (190)
- Begin development of design criteria and assessment of in-situ and ex-situ physical processes for remediation of explosives/organics-contaminated soils (896)
- Develop methods of assessing extraction techniques for metals-contaminated soils (390)
- Develop remediation technology modules for Groundwater Modeling Systems (200)
- Conduct field demonstration of SCAPS analytical/sampler interface (162)

FY 1997 Planned Program:

- Develop improved laboratory analytical methods for identifying organic contaminants in soils (300)
- Demonstrate thermal desorption sampler for volatile organic compounds and solvent detection (214)
- Complete design criteria and assessment of in-situ and ex-situ chemical processes for remediation of explosives/organics-contaminated soils (1442)
- Demonstrate physical separation technology for remediation of heavy metals-contaminated soils and test methods to predict mobility of metals (750)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602720A Environmental Quality Tech

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	54123	25887	24785	25107
Appropriated Value	54123	45663		
Adjustments to Appropriated Value (PE Total)	-1030			
a. SBIR/STTR decrement (-758)				
b. Reprogramming out of PE (-272)				
Current President's Budget Submit	53093	45663	21304	24164

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602782A Command, Control And Comm Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	10360	16827	15726	16251	17019	18437	19584	20089	Continuing	Continuing
AH92 Communications Technology	10360	9907	8830	8965	9262	9914	11053	11339	Continuing	Continuing
A779 Command/Control (C2) and Platform Electronics Technology	0	6920	6896	7286	7757	8523	8531	8750	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program contains two related projects: Communications Technology and Command/Control (C2) and Platform Electronics Technology. Faced with an increasing responsibility for meeting contingencies worldwide, field commanders must be capable at short notice of providing battlefield communications to and from virtually any place on earth. The Communications Technology project (AH92) explores the development of those advanced communications technologies required to provide a worldwide communications capability. The objective of the C2 and Platform Electronics Technology project (A779) is to expand scientific knowledge for demonstration of state-of-the-art technologies, including command/control and electronic systems/subsystems, performance reliability, maintainability, safety, survivability, and man-machine interface for all Army air and ground platforms, including soldier systems and equipment. Development of an infrastructure that will allow timely distribution, display and use of C2 data on Army platforms will lead to greater battlefield functional capabilities, survivability and total integration into the digitized battlefield. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this program element is related to and fully coordinated with efforts in PE 0603006A (Command, Control and Communications Advanced Technology) and PE 0602783A (Computer & Software Technology). It includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2. Work in this program element is performed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Fort Monmouth, NJ.

Project AH92 - Communications Technology: The exploratory development efforts in this project address the need for an increased communications capability required to support digitization of the battlefield. They are focused to meet the threat of electronic countermeasures (ECM), the need for survivability on the automated battlefield, and the need to avoid unauthorized access to friendly communications systems. This project contains exploratory development efforts for combat net radio in the high frequency (HF) and very high frequency (VHF) regions of the electromagnetic spectrum, and for common user technology in the ultra high frequency (UHF), microwave (MW) and millimeter wave (MMW) regions of the spectrum. The ECM and survivability technology programs include: multichannel services, distributed communications (photonic and fiber optic systems), internet architecture, integrated services, packet appliqués. Mobile Subscriber Equipment (MSE) applications, and frequency management. The communication security technology programs involve computer operating systems supporting Ada applications that will provide multilevel security for Army Tactical Command and Control System (ATCCS), prevent compromise of classified information, and protect against subversive software. Finally, this project addresses enhanced modeling of communications system capacity and dynamic field environments required to support the global deployment of new communications technology.

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FY 1994 Accomplishments:

- Delivered first breadboard of the reconfigurable multiband multimode radio, developed preliminary packet radio networking protocol, and developed proof-of-concept hardware on adaptive network radio (3158)
- Demonstrated tactical multinet gateway in laboratory demonstration (1622)
- Started development of network planner to obtain automated local area network (LAN) design tool capability (685)
- Performed experiments in LAN asynchronous transfer mode (ATM) testbed and completed photonics architectural study (1346)
- Designed and initiated fabrication of integrated photonic components for use in optical control of phased array antennas and in fiber optic transmitters and receivers (1775)
- Developed models for extremely high frequency (EHF)/super high frequency (SHF) propagation reliability, 24-hour multipath fading prediction, diffraction controlled link propagation, and improved systems performance models; conducted studies on line-of-sight antenna beamwidth effects, frequency engineering techniques, and ATM model structure (1774)

FY 1995 Planned Program:

- Demonstrate mobile ATM networks interconnection; initiate test of tactical multinet gateway (TMG) and the product manager (PM) Single Channel Common Ground Air Radio System (SINCGARS) internet controller (INC) (3475)
- Develop prototype aviation (laser) radio (1447)
- Design and develop two prototype UHF antennas to support satellite communications (SATCOM) on the move (965)
- Develop and demonstrate wideband HF antenna mounted on a standardized integrated command post (SICP) shelter and high mobility multi-purpose wheeled vehicle (HMMWV) (550)
- Fabricate photonic integrated phase and amplitude controller (IPAC) for integrated photonics sub-systems (1600)
- Develop algorithms used in burst propagation models to support communication realism for modeling and simulation products (1870)

FY 1996 Planned Program:

- Demonstrate ATM network management interim capability (2768)
- Develop and demonstrate wideband aerial relays and prototype personal communication system (PCS) wireless private branch exchange (PBX) for support of survivable adaptive systems and digital battlefield communications technology demonstrations, SATCOM on the move and the multiband multimode radio (1923)
- Develop prototype vehicular conformal antenna (1006)
- Conduct assessment of demonstrator and IPAC; initiate and complete subsystem testing (900)
- Demonstrate validity of improved spectrum efficiency modeling as it supports wide band data radios and high capacity trunk radio systems design and planning (2233)

FY 1997 Planned Program:

- Integrate mobile ATM broadcast network into the radio access point (RAP) (930)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602782A Command, Control And Comm Technology

- Integrate ATM management platform into the automated network management (AMN) product; demonstrate integrated operations of ATM and non-ATM based networks (1610)
- Demonstrate advanced wireless PBX system; initiate final distributed cellular communications control system (1485)
- Develop a laser modulator and detector prototype (1120)
- Evaluate prototypes of HF/VHF vehicular conformal antennas; conduct field and laboratory tests (624)
- Develop integrated subsystems for application of optical control of single beam phased array antennas and fiber optic point to point links, LANs and antenna remoting systems (1300)
- Develop software for modeling communications system capacity and performance and dynamic battlefield environments (1896)

Project A779 - Command/Control and Platform Electronics Technology: The objective of this project is the exploration of new concepts and techniques in command/control and platform electronics integration to achieve new and enhanced military functional capabilities. Emphasis is on aided pilotage, mission planning, precision navigation, command and control, soldier systems and integration with the evolving digital battlefield. New enabling technologies which support the current thrusts are also explored, such as controls and displays, voice interactive technology, fault tolerant processing, real time artificial intelligence processing, data transfer, distributed data bases and advanced open system architectures and integration concepts, which contribute to digitization of the battlefield and provide command and control on the move.

FY 1994 Accomplishments:
- Project funded in PE 0602211A, project AH85. Restructured to Project A779 in FY 1995.

FY 1995 Planned Program:
- Integrate aided pilotage capability onto testbed aircraft and conduct simulations for threat symbology and nap-of-the-earth (NOE) flight symbology (2531)
- Assess capabilities of mosaic flat panel for large screen panoramic display aviation applications (1078)
- Develop data preparation software for Aircraft Mission Rehearsal, a software package that produces a 3D real-time view which heightens the pilot's situational awareness (785)
- Demonstrate improved global positioning system (GPS) satellite selection algorithms utilizing the precision navigation system (2249)
- Evaluate expert system communication link manager system (132)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (145)

FY 1996 Planned Program:
- Initiate transition of aided pilotage program from contour to NOE flight by modifying the symbology and incorporating advanced color bases (4748)
- Develop and demonstrate C2 and platform electronic technology support tools such as course of action generation and execution monitoring (2148)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602782A Command, Control And Comm Technology

FY 1997 Planned Program:

- Complete transition from contour to NOE flight by modifying guidance algorithm and conduct flight tests (4976)
- Interface C2 and platform electronic technology decision support tools with the warfare simulator (WARSIM) 2000 or combined arms support task force evaluation model (CASTFOREM) computer-based, wargame simulation model; develop and demonstrate an enhanced collaborative planning tool for planning between multiple battlefield functional areas (2310)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	10321	16900	15865	16077
Appropriated Value	10321	16827		
Adjustments to Appropriated Value	39			
Reprogramming (39)				
Current President's Budget Submit	10360	16827	15726	16251

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602782A Command, Control And Comm Technology PROJECT AH92

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
AH92 Communications Technology	10360	9907	8830	8965	9262	9914	11053	11339	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Command, Control and Communications Advanced Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602782A Command, Control And Comm Technology

PROJECT: A779

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A779 Command/Control (C2) and Platform Electronics Technology	0	6920	6896	7286	7757	8523	8531	8750	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Command, Control and Communications Advanced Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602783A Computer And Software Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	6340	4529	3992	4342	4959	5732	5726	5873	Continuing	Continuing
DY10 Computer and Information Science Technology	3971	2467	2194	2361	2555	2647	2651	2718	Continuing	Continuing
A094 Tactical Software Technology	2369	2062	1798	1981	2404	3085	3075	3155	Continuing	Continuing

A. **Mission Description and Budget Item Justification:** This Program Element develops and applies software technology to improve the performance and reduce the cost of computer software for Army tactical, strategic, and administrative information systems, tactical embedded realtime systems, high performance computational technology and simulation technology. Tactical software technology efforts capitalize on computationally intensive approaches that exploit the rapidly evolving capabilities of emerging computer technology. Focus is on providing general solutions that can be applied to a wide variety of specific problems. Current examples include information distribution paradigms for constrained environments (e.g., bandwidth or security limited but not computationally limited), for application to tactical systems. Further specific concentrations are on applications to support tactical information distribution for situation awareness and interoperability of tactical systems. In the computer and information science technology areas, the efforts exploit advances in computer and communication technologies, and develop and modernize standard information management systems to support the soldier. The program addresses technical issues in the development of the Army's information mission areas of automation, communication, visual information, records management, and publication systems. In addition, the program investigates the infrastructure in communications and computers to support the information and communications needs of weapons technology. Work in this program element is consistent with the resource constrained Army Science & Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. This program is managed primarily by ARL. Efforts in this Program Element include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project DY10 - Computer and Information Science Technology: This project provides for the adaptation and application of research for the development and modernization of standard Army computer, command and control, and information systems. The project addresses technical issues in the development of an Information Architecture which will interconnect regional, local, and end user computing services resulting in a fully connected information management system with minimum data storage and maximum data access. The objectives of this project are to improve computer and communication system efficiencies by exploiting emerging technologies to reduce system development and maintenance costs and time, and to support modernization efforts of computing and communications hardware and software presently used in Army deployments throughout the world in both tactical and non-tactical environments. In addition, this project will facilitate transition to Ada for Army systems software development and achieve significant software reuse across Department of Defense (DoD) systems. The potential payoffs of this project are: measurable improvements in productivity and quality; reductions in utilization of life cycle resources by institutionalizing software management procedures and practices with savings in development and maintenance costs; increased communication systems capacity; responsiveness, reliability, interoperability, availability, and maintainability.

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FY 1994 Accomplishments:

- Integrated Automated Data Element Finder (ADEF) and Information Resource Investment Model (IRIM) to provide integrated support for data standardization across organizational boundaries. (819)
- Prepared technical report on designing/selecting representations for the reverse engineering of software as part of a continuing effort with National Science Foundation (NSF) software engineering center. (850)
- Provided guidelines on accommodating existing protocols in distributed systems in order to achieve interoperability and maintain performance. (1187)
- In dual use (information infrastructure) area, conducted experiments on the use of group tools (decision models) in assessing software modernization planning for software applications. Expanded models to include communication and data decisions. (613)
- Completed prototype to interface Computer-Aided Design (CAD) tool to database for Army installation asset management. (502)

FY 1995 Planned Program:

- Prototype and demonstrate software support for automated classification, storage and retrieval of office-level electronic files and records including e-mail; prototype a distributed digital library management system for training materials (dual-use). (555)
- Evaluate use of High Data Rate Communications via satellite for use in tactical telecommunications. (330)
- Expand decision model with IDEF (information engineering) to create an information architecture for the Army's installation environment. (644)
- Implement, test, and evaluate a rapid prototyping environment that generates correct Ada software from high-level specification; apply this technology to both real-time and information system software specifications. (564)
- Complete model to interface dissimilar communications protocols using Very High Speed Integrated Circuit Hardware Development Language (VHDL). (323)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (51)

FY 1996 Planned Program:

- Extend the rapid prototyping environment to incorporate automated selection of reusable Ada software modules; transition this environment to Army Life Cycle Software Engineering Centers (LCSEC). (398)
- Design and develop advanced concepts for integrating standard structured and unstructured data (such as textual correspondence and multi-media records and documents) into an architecture that enables efficient intelligent access to management of very large distributed multi-media heterogeneous databases and records repositories. (853)
- Demonstrate the utility of group support system technology in a distributed environment. (448)
- Investigate the feasibility of wireless Integrated Services Digital Network (ISDN) on the battlefield. (197)
- Demonstrate testing of executable specifications using VHDL. (298)

FY 1997 Planned Program:

- Design, implement, and test a process model for a collaborative software development environment that incorporates quality control methods such as formal inspection of software products and quality metrics. (424)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602783A Computer And Software Technology

- Implement, test, and validate the design for an integrated architecture for both structured and unstructured data; implement advanced indexing and organizational schemes for efficient retrieval of records and documents from very large multi-media repositories. (524)
- Expand the utility of group support technology through the integration of the ADEF tool. (716)
- Demonstrate synthesis of communication interfaces using VHDL. (374)
- Demonstrate wireless ISDN and Broadband ISDN connectivity on the battlefield. (323)

Project A014 - Tactical Software Technology: This project addresses the development of software techniques to exploit the rapid advances in computer (hardware) performance that is becoming equally available to both the scientific and tactical community. The vast gap in computational performance and capabilities that used to exist between computer systems in these two domains is rapidly diminishing. Computer power previously available only to scientists and engineers is now becoming routinely available to the warrior and new concepts for one domain will be applicable to the other. This project ensures that a fresh perspective on the application of this power is maintained. It concentrates on computationally intensive paradigms for information distribution and manipulation in severely constrained environments such as those encountered in the use of existing low-bandwidth tactical radios. This includes the automation of information exchange and research into the tactical aspects of the data abstractions of military concepts. Scalable, parallel computer architectures provide promise for achieving significant improvements in computational power for tactical applications. This project seeks to develop the computational technology to achieve efficient utilization of advanced computer architectures at the tactical level.

FY 1994 Accomplishments:
- Validated statistically a simulation of the Advanced Field Artillery Tactical Data System (AFATDS) throughput experiment conducted in FY 93. (822)
- Demonstrated route planning and dissemination in bandwidth-constrained environments suitable for situational awareness. (899)
- Designed and implemented automated network congestion control on low-bandwidth tactical channels via dynamic information thresholds. (648)

FY 1995 Planned Program:
- Integrate application-specific programs such as Command Information Processor and Weather Monitoring with IDT software to operate over narrow bandwidth communication links. (685)
- Adapt and demonstrate FY94 Information Distribution Technology (IDT) software in a realistic, heterogeneous, joint tactical environment such as the Combined Arms Command & Control Advanced Technology Demonstration (CAC2 ATD) at the Joint Warrior Interoperability Demonstration 95. (585)
- Develop and implement robust information recovery algorithms into fully automated IDT software package. (764)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (28)

FY 1996 Planned Program:
- Develop algorithms for integrating mission/route planning into IDT and subsequently into the digitization of the battlefield, (558)
- Exploit the database from the Joint Warrior Interoperability Demonstration 95 to improve the algorithms for automated information transfer by maximizing information throughput and minimizing communication delays. (550)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602783A Computer And Software Technology

- Adapt automated IDT software including prototype mission/route planning for use in the CAC2 ATD/ Digitization of the Battlefield exercises planned for FY 97. (690)

FY 1997 Planned Program:

- Demonstrate robust IDT that is able to recognize communication breakdown and automatically reestablishes and completes the interrupted information transfer. (698)
- Transition validated computationally intensive Command, Control & Communications (C3) IDT software to industry. (695)
- Incorporate validated automated route planning and adaptive distribution software into CAC2 ATD/Digitization of the Battlefield and demonstrate capability in field exercises. (588)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	5736	4635	4065	4351
Appropriated Value	5736	4529		
Adjustments to Appropriated Value	604			
a. SBIR/STTR decrement (-70)				
b. Reprogramming (+674)				
Current President's Budget Submit	6340	4529	3992	4342

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602783A Computer And Software Technology

PROJECT: DY10

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DY10 Computer and Information Science Technology	3971	2467	2194	2361	2555	2647	2651	2718	Continuing	Continuing

C. **Other Program Funding Summary:** N/A

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Computer Software Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602783A Computer And Software Technology

PROJECT: A094

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A094 Tactical Software Technology	2369	2062	1798	1981	2404	3085	3075	3155	Continuing	Continuing

C. **Other Program Funding Summary:** N/A

D. **Schedule Profile** The efforts funded in this project are non-system specific and represent continuing exploratory development research in the area of Computer Software Technology, therefore no milestones or events are provided.

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602784A Military Engineering Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	38259	40813	35220	37729	40343	44150	42666	43764	Continuing	Continuing
A855 Topography, Image Intelligence and Space Technology	9189	9211	8142	8831	9294	10112	10076	10335	Continuing	Continuing
AH71 Atmospheric Investigations	4586	5766	5416	5931	6306	6567	6155	6313	Continuing	Continuing
AT40 Mobility & Weapons Effects Technology	10576	12411	10812	11686	12674	13490	12004	12314	Continuing	Continuing
AT41 Military Facilities Engineering Technology	5355	5118	4453	4298	4767	5784	6088	6246	Continuing	Continuing
AT42 Cold Regions Engineering Technology	5804	5569	4292	4554	4750	5308	5450	5589	Continuing	Continuing
AT45 Energy Technology Applied to Military Facilities	2749	2738	2105	2429	2552	2889	2893	2967	Continuing	Continuing

A. Mission Description and Budget Item Justification The research conducted in this program element provides technology in direct support of the critical warfighter functions of mobility, countermobility, survivability, sustainment engineering and topography needed to win on the modern battlefield. Research is also conducted that supports the special requirements for battlefield visualization, tactical decision aids, weather intelligence products and capabilities to exploit space assets. Key operational technologies developed are demonstrated to Army units under program element #0603734A (Military Engineering Advanced Technology). Results are tailored to support the material development, test and acquisition community in evaluating the impacts of weather, terrain and atmospheric obscurants. Research develops and exploits a wide range of innovative technologies and applies them to Defense unique infrastructure planning, acquisition, revitalization, and sustainment processes. The goal of this research is to improve the efficiency and cost effectiveness of Defense infrastructure as it relates to supporting the training/readiness/force projection missions in garrison and force sustainment missions in theaters of operation. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on Civil Engineering and Environmental Sciences with oversight provided by the Joint Directors of Laboratories and Joint Engineers. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project A855 - Topography, Image Intelligence and Space Technology: This project funds the technology to enhance the tactical commander's ability to visualize the battlefield in an easily understandable, 3-D perspective and exploit his knowledge of combat relevant intelligence as a force multiplier to conduct and win Force XXI operations across the operational continuum. Using tactical/strategic/space sensor data, together with terrain data bases as input, the technology program emphasizes automating the processes of detecting changes on the battlefield, identifying battle significant features, exploiting space based/remote sensing information (especially for deep operations and over denied areas), and integrating the impacts of the battlefield environment to significantly improve combat planning and operations. Development

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efforts will enable the commander to locate and position enemy and friendly forces in day/night all-weather conditions, provide crucial terrain data for command and control systems (C2) as well as modeling and simulation systems, and enhance the speed and accuracy of maneuver and weapon systems. The technology being developed will help those who move, shoot, and communicate on the battlefield to "fight smarter" through superior knowledge of the total battlefield terrain and environment. Work in this project will develop an effective architecture to reuse standard digital mapping software for assuring that digital topographic data can be processed correctly and consistently to increase system interoperability in Army and/or joint operations. Weather/atmospheric effects data is provided by Army Research Laboratory Project AH71 in this PE. This work is managed by the US Army Topographic Engineering Center, Alexandria, VA.

FY 1994 Accomplishments:

- Established an image exploration research laboratory to conduct studies in the correlation of hyperspectral data and a reference signature library for natural and man-made materials. (3758)
- Developed digitized terrain-based mission planning and visualization test bed capability for evaluating dynamic terrain and environmental effects (2944)
- Developed software for automated drainage extraction on the terrain information extraction system (TIES) (1332)
- Developed testing and documentation criteria/procedures for entering mapping, cartography and geodesy (MC&G) software into the Army Software Reuse Center (555)
- Developed personal navigation and reporting system components identification and hybrid navigation (600)

FY 1995 Planned Program:

- Develop automated regional environmental effects summary and demonstrate laboratory feasibility for identifying natural and man-made materials from spectral signature data (3898)
- Develop initial DoD standard dynamic environment and terrain capability for operating in a field environment using high resolution, geometrically correct 3-D scenes, and implement automated elevation editing (3793)
- Develop an initial standard software architecture for digital terrain data import, datum transformation and coordinate conversions and display; and initiate procedures for preparing software for submission to the Army Software Reuse Center (920)
- Develop prototype model of personal navigation and reporting capability (600)

FY 1996 Planned Program:

- Develop and implement the automated environmental decision support system that portrays the battlespace environment to include automated data generation (3501)
- Establish virtual reality testbed for terrain and environmental applications (3780)
- Develop standardized basic software tools for data import, export, formatting and display, and populate Army Software Reuse library to increase system interoperability in Army/Joint operations (861)

FY 1997 Planned Program:

- Develop identification capability for natural and man-made materials using far-infrared spectral data and provide synthetic environmental scenario software (3569)
- Develop rapid, dynamic, 4-D battlefield environment/terrain visualization capabilities in a virtual reality environment for tactical applications (3962)

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- Develop an effective architecture for assuring that digital terrain data can be directly imported and processed by standardized MC&G software to increase system(s) interoperability with Army/Joint operations (1300)

Project AH71 - Atmospheric Investigations: This project realistically models atmospheric effects on target acquisition, mobility, lethality, and survivability to provide weather limitations for design and operation of smart weapons, improved war game realism and tactics and improved intelligence preparation of the battlefield. It develops weather decision aids for the commander applying advanced computer techniques; incorporates new technology in meteorological sensor design; develops data fusion techniques to horizontally integrate data from advanced weather sensors and non-weather sensors into decision aids to enhance combat power on the battlefield. This project supports Project Reliance theater data fusion and prediction, atmospheric effects assessment, and battlefield environmental effects sub-sub area joint programs. The work is managed by the Army Research Laboratory (ARL), Battlefield Environment Directorate, White Sands Missile Range, New Mexico.

FY 1994 Accomplishments:
- Configured battlefield/target area meteorological forecast model and automated decision aids on testbed for operational use on the integrated meteorological system Block II (1951)
- Conducted acceptance testing, field testing, and demonstration of the ability to model the atmosphere in the target area and increase accuracy of weapons (868)
- Integrated multiple weather sensor, improved performance characteristics, and fully documented the mobile atmospheric profile (869)
- Incorporated effects of target and scene shadows on target acquisition into the target acquisition (TARGAC) model (491)
- Developed tactical decision aid for the detection of acoustical sources, assuming a non-turbulent planetary boundary layer over flat terrain (407)

FY 1995 Planned Program:
- Integrate realistic weather effects into advanced technology demonstrations and the Army Battle Labs models (1213)
- Develop and evaluate new versions of "best met" and "met partials" techniques for implementation of computer assisted artillery meteorology on the advanced field artillery system (AFAS) and other field artillery delivery systems (1449)
- Exploit meteorological satellite and atmospheric profiling technology to collect critical environmental data, and execute Mobile Profiler radar design improvement (1449)
- Develop a tactical decision aid for displaying sound pressure levels in the two dimensional turbulent planetary boundary layer over flat terrain (774)
- Incorporate terrain and weather effects into operational chemical/biological hazards prediction model (881)

FY 1996 Planned Program:
- Develop friendly/threat comparison module for integrated Weather Effects Decision Aid for use on Army common hardware/software (2000)
- Exploit tactical geosynchronous meteorological satellite receiver technology to improve temporal resolution of battlefield/target area weather data. (657)
- Develop prototype mobile profiling system (MPS) in order to be more deployable; improve MPS satellite profiles; and perform cost benefit analysis of mesoscale model for artillery accuracy (1172)
- Develop user interface for 2-dimensional limited complex terrain acoustic propagation model (785)

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- Integrate realistic hazard predictions from chemical-biological agent into war game models (802)

FY 1997 Planned Program:

- Through Project Reliance, incorporate Navy's nonhydrostatic technology into battlefield/target area meteorological forecast model for higher spatial resolution and more accurate atmospheric characterization (1736)
- Integrate complex terrain acoustic detection tactical decision aid into Army common hardware/software and configure for operational use (1048)
- Provide "exact" meteorology for trajectory models at 0.1 second intervals along projectile path to target (1184)
- Develop decision aid for displaying sound levels as a function of range and direction in the 2-dimensional planetary boundary layer over limited complex terrain (1083)
- Adapt direct numerical simulations for operational/DIS chemical/biological hazard modeling (880)

Project AT40 - Mobility and Weapons Effects Technology: This project will provide warfighters the technologies for: rapid establishment and repair of lines of communications by both light and heavy engineers in support of US force deployment; optimal obstacle siting based on accurate predictions of enemy movement and the synergistic effects between obstacles and weapons systems; rapid obstacle and barrier creation; accurate assessments of battlefield mobility for maneuver commanders (and materiel developers during virtual prototyping); methodologies to predict coastal effects on logistics-over-the-shore (LOTS) operations; camouflage, concealment, and deception for fixed facilities to deny accurate acquisition and engagement by threat weapon systems; and designs, materials, and construction methods for battlefield, fixed, and forward base survivability against advanced conventional weapons and terrorist weapons. Civil engineering science and technology (S&T) in this project directly supports the Army's DoD Project Reliance S&T responsibilities in airfields and pavements, survivability and protective structures, and sustainment engineering. The work is managed by the US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

FY 1994 Accomplishments:

- Transitioned stochastic mobility techniques for field evaluation; validated mobility inference algorithms in two climatic regions; described soil dynamics of maneuvering vehicles on deformable soil (1565)
- Developed and integrated direct-fire/obstacle synergistic relationship algorithms, tactical dam analysis model, and reservoir outflow model into obstacle planning software (845)
- Developed a logistics-over-the-shore simulation planning model for prediction of logistics throughput; developed and validated logistics convoy operation system assessment model (885)
- Established design criteria for Army technical manual (TM) 5-855-1 for anti-penetration shielding to defeat advanced design projectiles; upgraded vulnerability analysis methodology for structural response from direct hit using in-structure shock code (2297)
- Developed analytical model for predicting response of aircraft to pavement roughness and completed physiochemical testing of asphalt binders and mixtures. (825)
- Conducted evaluations and field experiments of materials and methods for stabilization of dry soils (765)
- Evaluated advanced materials for expedient protection for mobile command centers, parked army aircraft, and their supporting assets and developed survivability algorithms for simplified survivability assessment procedure for troop use (734)
- Developed high efficiency standoff assault breaching, bridge demolition and road cratering techniques (800)

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- Developed basic camouflage, concealment and deception (CCD) design guidance for new/hardened construction and radar design module and radar terrain/target database for CCD research work-station (1110)
- Developed and tested techniques for upgrading windows to resist blasts from terrorist vehicle bombs (750)

FY 1995 Planned Program:

- Develop a stochastic mobility model with capabilities to quantify reliability of predictions and measures of risk; develop algorithms describing torque/traction/soil motion resistance of maneuvering vehicles on deformable soil (1640)
- Develop and integrate indirect-fire/obstacle synergistic relationship algorithms and riverine analysis model into obstacle planning software (949)
- Construct a theater infrastructure assessment model integrating convoy operation system assessment and logistics-over-the-shore models; provide real-time sea state forecast (1412)
- Evaluate effectiveness of new high-strength, high-ductility materials against hard target penetrators; upgrade designs and unprotected versus protected vulnerability evaluations for generic hardened facility subjected to direct hits (2450)
- Establish design criteria for use of modifiers in asphalt concrete to improve durability, reduce maintenance costs, and increase pavement life (1200)
- Develop methods for rapid stabilization of loose dry soils in arid regions to provide operating surfaces (paved and unpaved) for contingency military operations. (905)
- Determine protective measures that will increase the survivability of brigade and division command centers without interfering with mobility and operational requirements (900)
- Develop techniques or methodologies for rapid obstacle creation immediately following last use of terrain and lines of communications by friendly forces (975)
- Establish design criteria for chapter on camouflage, concealment, and deception for Army Technical Manual 5-855-1 (1000)
- Finalize design procedures for hardening windows and doors to bomb threats, and produce initial version of personal computer code for blast response of air-gap windows (980)

FY 1996 Planned Program:

- Determine pressure/sinkage algorithms that account for soil's cyclic remolding produced by multiple vehicle passages; validate and document mobility data inference routines for the world's major climatic zones (1747)
- Develop and integrate knowledge-based decision making algorithms for obstacle placement into obstacle planning software (OPS) (960)
- Conduct two-dimensional laboratory experiments of concepts for rapidly emplaced breakwaters; incorporate engineer workload determination and resource allocation in theater infrastructure planning and assessment model (955)
- Perform subscale experiments of robust penetrators against layered targets; develop vulnerability analysis computer code for field evaluation (2175)
- Develop design and construction guidance for pavement joints and pavement smoothness; complete critical pavement durability parameter investigations. (950)
- Conduct field evaluations of lightweight expedient surfacing for contingency operating surfaces (625)
- Evaluate concepts for deployable protective field fortifications for light forces; determine applicability of existing terrorist threat countermeasures for deploying forces (925)

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- Develop precise techniques to predict the effects of localized, point-of-attack target damages on entire structures; conduct field experiments of assault breaching and obstacle creation technologies (980)
- Provide fully dynamic 3-D environmental information base procedures for infrared (IR) signatures; develop CCD measures for Army aviation fixed/long-dwell facilities (795)
- Develop methodology and databa.- for designing construction components to resist "very low" and "low" forced entry threat levels; develop analytical procedures for predicting component delay times to "medium" threat severity (700)

FY 1997 Planned Program:

- Complete development of first generation robust theoretical mobility model incorporating non-linear and hysteretic vehicle-terrain interaction; complete development of automated methods to rapidly derive, from standard available data, world-wide high-resolution mobility model input data (1980)
- Evaluate integrated obstacle planning software (OPS) algorithms during full-scale field training exercise (1035)
- Conduct 3-D lab-scale experiments of rapidly emplaced breakwater concepts for logistics-over-the-shore operations (1070)
- Develop design criteria for complex layered antipenetration systems to defeat large penetrating munitions (2290)
- Synthesize theoretical equations, laboratory experiment results, and field data into a preliminary interactive analytical pavement response and performance model (1100)
- Demonstrate advanced materials for construction of operating surfaces on soft soils; provide guidance for design, placement, and procurement of materials for soft soil stabilization for integration into TM 5-430-00-2 (1250)
- Complete protective concepts for US Army aircraft parked in forward battle areas, criteria and guidance for the protection of deploying forces from saboteur attack, and concepts for protective shelters packages for light forces (950)
- Develop analytic techniques and software suitable for soldier use to predict demolitions effects on reinforced concrete and rock structural targets (490)
- Conduct fixed/long-dwell facility decoys experiments; analyze sprayable radar absorbing material coatings with visual and thermal camouflage properties (646)
- Finalize design procedures for blast response of cavity walls; develop methodology and database for designing construction components to resist "high" forced entry threat levels (875)

Project AT41 - Military Facilities Engineering Technology: This project exploits innovative developments in a wide range of technologies to achieve critically needed cost reductions in Army facility life cycle processes (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal). Current Army infrastructure related costs alone are about $7 billion/year. The national military strategy goal is to reduce facility infrastructure life cycle costs by 20% by FY 2000. Meeting this critical goal is not possible without application of significant technology innovation. Technology innovations already developed and projected for the future have high civilian sector dual use potential and interest and include innovations in material science, composite materials, operations research, systems analysis, robotics, concurrent engineering, collaborative decision support, knowledge-based systems and object-oriented modeling and simulation. As a side benefit, significant soldier retention benefits also accrue from providing high quality, professional work environments and high quality communities for military families. Under the DoD Project Reliance initiative, the Army is responsible for meeting the conventional facilities research and development needs of all the military services. The work is managed by the Construction Engineering Research Laboratory, Champaign, Illinois.

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FY 1994 Accomplishments:

- Completed design review assistant system to improve design quality and to reduce costs of facility acquisition through generation of lessons learned (1852)
- Developed a lead-based paint removal and hazard mitigation technique using new and emerging technologies, including vacuum blasting and heat gun for Army lead-based paint removal program (825)
- Tested energy dissipation technologies and developed criteria for improving seismic performance for upgrading existing Army facilities (667)
- Demonstrated a model for intelligent agents to support installation knowledge worker system use at installations (650)
- Completed process modeling for public works resource optimization (1077)
- Developed analytical procedures for evaluating effectiveness of ferromagnetic shields (284)

FY 1995 Planned Program:

- Establish capability to support design quality via computer aided design (CAD) standards verification (1636)
- Test retrofitted complex concrete and masonry systems and develop seismic strengthening techniques for Army facilities (411)
- Field test super polymer scale/corrosion resistant condensate pipe coatings and robotic crawler corrosion assessment system (1060)
- Provide next-generation integrated decision support environment to exploit collaborative object oriented simulation analysis techniques (846)
- Establish condition indices and prediction models for an engineered management system for buildings (1165)

FY 1996 Planned Program:

- Develop engineered management system for buildings. (1115)
- Evaluate smart roofing systems and construction materials recycling for design, repair and revitalization of Army facilities. (874)
- Develop capability for integrated construction CAD, visualization, cost estimating, and scheduling (1534)
- Test pre-cast concrete wall connectors for seismic retrofit (400)
- Provide performance support environment for installation knowledge worker productivity and effectiveness (530)

FY 1997 Planned Program:

- Integrate Commander's public works maintenance management models and algorithms for optimal maintenance and repair resource allocation with special emphasis on automated inspection procedures (900)
- Demonstrate concurrently engineered facility delivery process that facilitates multiple discipline interaction (1634)
- Develop criteria for recycling construction and demolition materials (930)
- Create seismic protection technique for non-structural building components (520)
- Develop conductive concrete for electromagnetic shielding applications (314)

Project AT42 - Cold Regions Engineering Technology. This project is the only DoD exploratory development program focused on the knowledge base and engineering principles needed to sustain an effective war fighting force in winter and the cold regions of the world, including combat support, combat engineering and base/facility

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construction, operation and maintenance. Research directly lowers high life-cycle costs and extends the abbreviated service life of DoD facilities subjected to winter and extreme cold conditions, as well as providing a basis for extending the operability of forces and material to cold climates with minimized capability and cost penalties. Research supports readiness and effectiveness of DoD conventional, light, and special operations forces in the arctic, Alaska, Scandinavia, Korea, Japan, Europe, the US northern tier and other remote/high altitude environments. This program is a source of special technologies for civilian engineering and environmental applications not obtainable through the private sector. This program is essential to improving US projection of power and operational capabilities in winter and the cold regions of the world. The work is managed by the Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

FY 1994 Accomplishments:

- Defined temporal and spatial variability of snowpack at radar wavelengths impacting smart weapon performance (891)
- Incorporated freeze/thaw soil mobility prediction algorithms into Army mobility predictions and demonstrated new capabilities for combat engineer vehicle excavation in frozen soil (2160)
- Developed specifications and awarded a contract to procure a state-of-the-art load bridge to validate a mechanistic pavement design model, and developed design guidelines for buildings, roofs, walls and insulated foundations in cold regions (2753)

FY 1995 Planned Program:

- Develop radar backscatter model for synthesis of winter background scenes including analysis for optimizing seismic/acoustic system performance for smart weapons and mines (1998)
- Develop advanced design concepts for light excavation equipment in frozen ground supporting lines of communications (LOC) (745)
- Develop standards that permit the cost-effective placement of concrete at temperatures down to -10 degrees C, mechanistic design and evaluation of pavements in cold regions and design/construction of "low temperature" heat distribution systems (2826)

FY 1996 Planned Program:

- Complete millimeter-wave radar backscatter model, preliminary active infrared (IR) model and dynamic rendering for inclusion in smart weapons operability enhancement (SWOE) program (1905)
- Complete the first generation deep snow model for the comprehensive Army mobility model system (CAMMS) and provide cold weather data bases for corps battlefield simulation (CBS) and Janus wargame model, and develop an interim database of winter effects of combat engineer operations (1449)
- Develop interim guidelines for long-lasting, low-maintenance coatings and application procedures for concrete brick and masonry buildings supporting military infrastructure repair, operation, and design cost reduction program (938)

FY 1997 Planned Program:

- Complete mobility modeling for shallow and deep snow, thawing soil conditions and surface icing for combat engineer mission analysis for operations in a winter environment (1774)

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- Complete basic radio frequency (RF) band environmental features signature model for simulation, design, and for advanced automatic target recognition (ATR) system (889)
- Validate developed materials for low-temperature repairs to concrete, brick and masonry and interim design guidance for use of waste material in pavements supporting military infrastructure repair, operation and design cost reduction (1891)

Project AT45 - Energy Technology Applied to Military Facilities: Energy for Army facilities is essential for the modern Army to meet its mission. The research conducted in this project provides the technology for providing energy efficient facilities, adapting new energy source technologies to military facilities, adapting renewable technology to Army scale facilities, and improving the efficiency of Army unique on-site central energy plants. Research focuses on leveraging industry technology investments and integrating a broad range of advanced technologies into a comprehensive system to meet the specialized needs of the Army occasioned by size, age and mission dependent operational standards. Activities include modeling and simulation of thermal loops and electrical systems, constructing new analytic techniques, and developing new system designs and new hardware in conjunction with industry. Research products/systems are integrated in a "low energy" model installation program. Research products are transferred to the field and used in new construction and in upgrades of existing facilities. The Executive Order implementing the Energy Policy Act of 1992 requires the Army to reduce energy consumption 30% by 2005 from the 1985 base line. The work is managed by the Construction Engineering Research Laboratory, Champaign, Illinois.

FY 1994 Accomplishments:
- Developed energy design tools for military facilities using Army design software program (689)
- Developed thermal energy distribution system operation model with CAD user interface (846)
- Modified heating, ventilation and air conditioning (HVAC) system designs for special purpose application for Army facilities (625)
- Provided technologies to reduce energy system harmonics on Army installations, developed lighting retrofit guidance, and developed a refrigeration management system (589)

FY 1995 Planned Program:
- Incorporate collaborative methods into existing concurrent engineering software for energy efficient facilities (934)
- Develop central energy plant operations management system and advanced gas distribution system (474)
- Develop indoor air quality detection and diagnostics model (809)
- Establish methods for electric/motor drive analysis and selection for retrofits to Army facilities (463)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (58)

FY 1996 Planned Program:
- Develop computer assisted training modules to reduce the training burden of fielding embedded assistant design agents for achieving energy efficient facilities (760)
- Develop screening criteria for selecting the most energy efficient and cost effective energy supply technologies for a particular DoD requirement (480)
- Develop refined cost-benefit model for prioritization of energy conservation alternatives applicable to DoD facilities (600)

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- Develop energy usage - workforce productivity relationship model (265)

FY 1997 Planned Program:

- Create concurrent engineering capability for energy system design (785)
- Develop methods for adopting fuel cell technology in Army energy plants (580)
- Develop standard distributed digital and energy management control panel for Army HVAC systems (663)
- Develop methods for using high efficiency lighting technologies to reduce electrical costs while improving efficiency and effectiveness (401)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	41377	41201	34890	36951
Appropriated Value	41377	40813		
Adjustments to Appropriated Value (Total PE)	-3118			
a. SBIR/STTR decrement (-47)				
b. Reprogrammed out of PE (-3071)				
Current President's Budget Submit	38259	40813	35220	37729

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DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602785A Manpower/Personnel/Trng Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	12181	10031	7500	10055	10700	11907	11387	11683	Continuing	Continuing
A790 Personnel Systems and Performance Technology	3481	3119	2653	3116	3232	3707	3711	3807	Continuing	Continuing
A791 Education and Training Technology	8700	6912	4847	6939	7468	8200	7676	7876	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objective of this program element (PE) is to provide a scientifically-sound basis for maximizing soldier and unit performance through empirical research, the results of which lead to cost-effective training strategies for synthetic training environments, optimum simulator designs to achieve maximum learning at minimum cost, enhanced battle command performance, and improved selection and classification of soldiers to maintain the Army's warfighting edge. The majority of the research conducted in this PE transitions to manpower, personnel, and training advanced development work in PE 0603007A. Work in this PE is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. These projects include non-system specific development efforts pointed toward specific military needs and are therefore appropriate to Budget Activity 2. This PE is managed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), Alexandria, VA.

Project A790 - Personnel Systems and Performance Technology: The objectives of this project are to provide the scientific basis for improved methods for leader assessment and development, enhanced selection and classification procedures to ensure the right person is placed in the right job, improved organizational design to enhance warfighting decision making, and methods for determining effective utilization of soldiers with minimal entry qualifications. This project will also develop methods for effective organizational design and leadership. Research under this project supports the manpower and personnel Defense technology area.

FY 1994 Accomplishments:

- Developed techniques to identify the decision-making requirements of command and control tasks and identified critical competencies for battalion level battle commanders (1486)
- Identified predictors of cadet leader development (274)
- Developed a model of key leadership and organizational strategies which influence attitudes and commitment of survivors of downsizing (406)
- Developed strategies to counter the effects of coaching and faking on temperament measures (596)
- Developed methods for identifying optimal job assignments for lower aptitude personnel (272)
- Conducted experimental investigation of issues related to ensuring survey data quality (447)

FY 1995 Planned Program:

- Evaluate a new paradigm of distributed battle command planning and decision making including the development of staff group design modeling tools (473)
- Develop new measures of performance-related aptitude, leadership, and stress tolerance (742)

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- Model the leader development process including the relationships among problem-solving capabilities, leadership style, and rated effectiveness (808)
- Develop new selection techniques for enlistees with low mental aptitude scores (100)
- Conduct analyses on the long-term effects of peacekeeping missions on soldier career development (301)
- Conduct a broad-range investigation of the selection, training, integration, and development of reserve volunteers for peacekeeping missions in the Sinai (630)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (65)

FY 1996 Planned Program:
- Validate new measures of performance-related aptitude, leadership, and stress tolerance (508)
- Model the development of commander knowledge and skills (381)
- Develop methods for measuring the leadership knowledge acquired through operational experience (602)
- Conduct cross-sectional analyses of lessons learned in peace operations using life course methodologies (209)
- Develop prototype whole-Army system for classifying jobs (457)
- Identify economic, family support and career commitment factors that influence a reservist's decision to volunteer for operations other than war (496)

FY 1997 Planned Program:
- Develop structural models of impact of peacekeeping operations on career development and commitment (665)
- Complete development of new measures of aptitude related to enlisted leader performance requirements (460)
- Design techniques for developing and training decision making skills (255)
- Develop taxonomy of field grade officer leader requirements and new measures for assessing leadership potential in officer candidates (937)
- Evaluate prototype whole-Army system for classifying jobs (439)
- Determine the effects of volunteer missions on home-unit readiness of reserve units (360)

Project A791 - Education and Training Technology: The objectives of this project are to provide the behavioral technology required for the development of effective individual and collective (unit) training strategies using simulation-based synthetic environments. Research conducted in this project builds on recent advances in the cognitive sciences and will provide an empirical basis for improved collective (unit) training strategies and techniques for brigade and below, training methods for night operations, individual training strategies exploiting "virtual reality" technology for training and rehearsal of warfighting missions and operations other than war (OOTW), "intelligent tutor" technology for foreign language training, and determination of task-based fidelity requirements for cost-effective simulator training on selected aviation tasks. Research under this project directly supports the training systems Defense technology area.

FY 1994 Accomplishments:
- Assessed the capability of performing land navigation and target detection in a virtual reality environment (1571)
- Tested prototype unit skill acquisition and retention model using armor platoon tasks in a simulated training environment (1752)
- Determined team coordination training requirements for medical emergency teams (1511)

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- Determined visual scene requirements for helicopter gunnery training (1294)
- Determined database texture requirements for nap-of-the-earth helicopter flight training in simulators (2572)

FY 1995 Planned Program:

- Develop and evaluate field expedient methods for maximizing soldier visual acuity at night (431)
- Demonstrate a portable, computer-based foreign language tutor prototype (659)
- Develop model for predicting amount of training needed to retrain mobilized soldiers (421)
- Develop prototype training methods to facilitate team training and the acquisition of collective skills in a distributed interactive simulation (DIS) environment (1285)
- Empirically determine the content requirements of flight simulator scenes for critical aviation tasks (2596)
- Develop and demonstrate multi-service training methods in a DIS environment (770)
- Determine performance and training requirements for future digitized forces (750)

FY 1996 Planned Program:

- Design and test methodology for developing brigade and multi-service training and assessment programs (981)
- Determine display resolution requirements for flight simulator-based task training (2176)
- Develop training technologies for digitized armored forces (Force XXI) (979)
- Develop training techniques for using image intensification and infrared sensing devices to enhance performance in night operations (711)

FY 1997 Planned Program:

- Determine fidelity required in virtual reality environments for aircrew mission planning and rehearsal (2905)
- Develop training and performance evaluation techniques to support Force XXI digital capabilities (1822)
- Develop prototype simulation-based immersive training techniques for use in operations other than war (1234)
- Validate prototype training and measurement methodologies for improving performance at night (978)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	13319	10484	9161	10026
Appropriated Value	13319	10031		
Adjustments to Appropriated Value	-1138			
a. SBIR/STTR Decrement (-65)				
b. Reprogramming Total (-1073)				
Current President's Budget Submit	12181	10031	7500	10055

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COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A790 Personnel Systems and Performance Technology	3481	3119	2653	3116	3232	3707	3711	3807	Continuing	Continuing

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**: The efforts funded in this project are non-system specific and represent exploratory development in the area of personnel systems and performance technology, therefore no milestones are provided.

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BUDGET ACTIVITY: 2 - Exploratory Development	PE NUMBER AND TITLE: 0602785A Manpower/Personnel/Trng Technology		PROJECT: A791

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A791 Education and Training Technology	8700	6912	4847	6939	7468	8200	7676	7676	Continuing	Continuing

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**: The efforts funded in this project are non-system specific and represent exploratory development in the area of education and training technology, therefore no milestones are provided.

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BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602786A Logistics Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	30472	34110	28036	27530	29206	30628	30429	31249	Continuing	Continuing
AH20 Mobility Equipment Technology	7323	9457	7203	7397	8173	8953	8253	8458	Continuing	Continuing
AH98 Clothing & Equipment Technology	3964	11966	12615	12886	13370	13588	13887	14277	Continuing	Continuing
AH99 Joint Services Food/System Technology	4587	5202	5409	5567	5731	5901	6099	6269	Continuing	Continuing
DJ10 Combat Rations Quality Enhancement	4020	2719	1263	0	0	0	0	0	0	8002
D283 Airdrop Advanced Technology	1996	1924	1546	1680	1932	2186	2190	2245	Continuing	Continuing
A427 Tactical Shelters	2582	2842	0	0	0	0	0	0	0	5424

A. Mission Description and Budget Item Justification: Next generation and future hardware will place unusual demands on the soldier and future Army logistics systems. In order to achieve the logistics efficiency and responsiveness that will be required, there must be associated technology developments evolving in logistics equipment, supplies, and systems to make them smaller, lighter, more reliable and durable, more survivable, less manpower intensive, and more mobile. Technology efforts on clothing and equipment and on field shelters provide enhanced individual soldier protection from both combat threats and from the natural field environment. The Joint Services Food/System Technology program supports all the military services, the Special Operations Command, and the Defense Logistics Agency with research and development of advanced military food products, packaging, and combat food service equipment. The Combat Ration Quality Enhancement project will establish quality quantification parameters and criteria to minimize physical, chemical, and nutritional degradation of combat rations, thus maintaining/enhancing acceptance and consumption by the military community. Similarly, work on advanced airdrop technology supports all Services' requirements for dropping larger combat and logistics loads while improving delivery accuracy, minimizing vulnerability of aircraft and reducing life cycle costs. Moving men and equipment in support of the ground Army is the focus of investigation into mobility equipment technology. This includes renewed emphasis on landmine detection and neutralization, countersurveillance, improved warehousing and supply distribution, and low-signature, high efficiency mobile electric power sources. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. It adheres to Tri-Service Reliance agreements on clothing, textiles, and food, as well as fuels and lubricants with oversight and coordination provided by the Joint Directors of Laboratories. There is no unwarranted duplication of effort among the military departments. Efforts are coordinated with those in PE 0603001A (Logistics Advanced Technology). The program is managed primarily by the U.S. Army Natick Research, Development and Engineering Center, Natick, MA. Research in this program element includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2.

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Project AH20 - Mobility Equipment Technology: This exploratory development program addresses the need for advanced combat support and combat service support equipment and material. The project is directed toward providing the technology to solve deficiencies in the Army mission areas of engineer-mine warfare and combat service support. It includes efforts in low-cost signature reduction, countersurveillance, deception, survivability, countermine, logistic supply and support, materials, mobile electric power, environmental control, and corrosion. Fuels and lubricants technology work conducted under Project AH20 in prior years will be transferred to PE/Project 0602601A/AH91 beginning in FY 1996.

FY 1994 Accomplishments:

- Designed, fabricated and tested commercial engines and generators for individual soldier power (1155)
- Assessed performance data regarding configurations with new polymeric materials (82)
- Completed field demonstration of new single hydraulic fluid and transitioned to field (637)
- Designed low burden appliqués to reduce detection ranges by 50% for mobile assets in woodland/desert/arctic/urban battlefield environments (916)
- Evaluated different algorithms with various detector arrays to optimize sensor performance for false alarm rate reduction (1465)
- Designed and build smart mine end-to-end simulator for use in the joint Army/Marine Corps off-route smart mine clearance program (1060)
- Studied the effects of a directed energy charged particle beam against mines (1559)
- Designed, fabricated, and tested a portable water chiller for use with tank trailers (449)

FY 1995 Planned Program:

- Develop and complete fuel injector work for 8 pound engine-generator system for soldier micro-climate cooling module (963)
- Evaluate capability of novel polymer and inside skin hollow fiber membrane to desalinate and remove nuclear, biological, chemical (NBC) contaminants (244)
- Complete full-scale powertrain performance evaluations with candidate environmentally compliant combat engine oil using kerosene and distillate fuels (521)
- Test/evaluate ability of reduced signature appliqués for rapid force projection vehicles to deny enemy surveillance of friendly activities (2223)
- Build and test detector arrays for the Vehicle Mounted Mine Detector test bed and transition to advanced development at completion of test (1805)
- Test and evaluate performance of smart mine emulator and counter-measure techniques; transition emulator to support off-route smart mine clearance advanced development (1615)
- Evaluate combining a forward looking detector (microwave or infrared) with a directed energy or explosive projectile to create a mine-hunter killer (2086)

FY 1996 Planned Program:

- Develop multisensor deception materials and collect field data to validate representation of low observables in target acquisition/wargame simulations (2426)
- Evaluate imaging infrared (IR) and frequency agile radar on mobile combat vehicle testbed; develop preliminary design of directed energy neutralization system (3129)
- Conduct castforem simulations to develop scenarios for countermine demonstration; select software architecture and insertion points for integrating mine/countermine functions in distributed interactive simulation (DIS) environment (748)
- Complete design, fabrication and testing of hydrogen/air fuel cell power source for the 21st Century Land Warrior (21 CLW) microclimate cooling system and battery charger; complete fabrication and testing of pressurized hydrogen/oxygen fuel cell (752)

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- Complete fabrication and testing of 500 watt and 1500 watt lightweight generators which run on JP-8 (Army one fuel forward) and utilize Advanced Research Projects Agency (ARPA) developed permanent magnet generators and advanced fuel injection hardware (148)

FY 1997 Planned Program:

- Demonstrate passive low observable/deception technologies for suppression of mobile and semi-mobile assets' multispectral signatures reducing detection ranges by 50 percent in woodland, desert, arctic and urban battlefield environments (2366)
- Downselect between imaging IR and frequency agile radar for application to the mine hunter-killer; fabricate and integrate directed energy brassboard system (3861)
- Reduce weight and size of the fuel cell power source, improve thermal management and hydrogen generation techniques, and reduce noise and thermal signatures of the vapor compression components and fuel cell for an optimized microclimate cooling system for 21 CLW (1004)
- Develop miniature, lightweight piezoelectric fuel injection for reduced emissions and fuel consumption of small gasoline engines converted for JP-8 fuel operation; fuel injection design will have direct application for commercial gasoline conversion to meet Environmental Protection Agency (EPA) emissions regulations (166)

Project AH98 - Clothing and Equipment Technology: This exploratory development improves soldier survivability and performance through significantly improved materials and new design applications for combat clothing and personal equipment. Areas of emphasis include material development to improve: ballistic, chemical/biological, flame, nuclear thermal, and directed energy protection; enhanced countersurveillance/camouflage; microclimate conditioning; materials/concepts for protection in arctic/desert environments; and improvements to lighten the soldier's load. Human factors research and simulation and modeling tools applicable to the soldier system are used to quantify soldier performance and determine optimal Research and Development (R&D) alternatives.

FY 1994 Accomplishments:

- Analyzed the mechanisms of penetration/propagation of high potential fiber-based materials under ballistic impact; characterized composites and silk fibers to determine potential application in individual ballistic protective systems (2351)
- Completed reflective technology for multi-line laser eye protection for the land warrior and transitioned to development; assessed flammability and thermal transport of military uniform systems when challenged by lasers and thermal-nuclear pulses (1760)
- Optimized materials and components for integrated protection technology, microclimate cooling, heads-up in-helmet displays, and flame resistant insulation materials; developed anthropometric models for computer-aided design (2251)
- Evaluated, modified, and adapted biomechanical methods used by the sports shoe industry to improve military footwear and reduce injuries (200)
- Identified potential coatings and application technologies with controlled emissivity for thermal signature-reducing (i.e., extended camouflage) textile systems (754)
- Developed permeable/impermeable chemically protective materials with increased durability/flame resistance and minimal weight/bulk; evaluated novel membranes which allow selective passage of moisture vapor, but not nuclear, biological and chemical (NBC) agents (1144)
- Extended Small Unit Simulation System to platoon level force-on-force simulation, quantifying with high resolution the vulnerability, lethality, and mobility effects of explicit changes to selected items of soldier's clothing and equipment (1504)

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FY 1995 Planned Program:

- Construct/evaluate flame resistant combat uniform shell fabrics and insulation materials for cold weather clothing; refine material system for use on electrically heated handwear; design lightweight modular microclimate cooling system concepts using recent advancements in compressors, heat exchangers, and materials (1850)
- Select/evaluate materials and designs for field footwear to enhance soldier biomechanical efficiency and reduce soldier foot injuries; enhance the crew station and combat uniform design capabilities of the human figure performance model by integrating clothed anthropometric and range-of-motion data (750)
- Produce/isolate/purify lighter weight silk protein materials for use in individual ballistic protective systems (1074)
- Optimize performance of textile-based materials for use in soft and composite armor system for fragmentation protection; investigate small arms protection concepts showing low weight and bulk for individual ballistic protective systems (2500)
- Refine advanced multi-spectral camouflage materials to minimize adverse effects on combat uniform fabric systems (1628)
- Develop laser eye protection for use both day and night to protect against three laser lines (532, 694, and 1064 nanometer); measure/test the efficacy of nonlinear materials for tunable protection (652)
- Optimize performance of selectively permeable membranes for use in chemical protective clothing to allow higher rates of water vapor transmission with reduced chemical agent penetration; optimize permeable chemical protective materials with increased durability and flame resistance (911)
- Develop first generation soldier-on-the-battlefield simulation software for virtual prototyping to reduce soldier system design costs and reduce risks to the individual soldier; use first generation Distributed Interactive Simulation (DIS)-certified Soldier System Model to develop baseline and projected 21st Century Land Warrior (21 CLW) survival and performance data for use in Army combat models (2563)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (38)

FY 1996 Planned Program:

- Conduct optimization of components for multiple ballistic threat protection (fragments and small arms) to provide improved body armor and helmets for soldiers and police; determine viability of flexible ballistic protective materials system for small arms protection through analytical and experimental analysis; begin integration studies and armor effects investigation for multiple ballistic threat protective components (2950)
- Develop first generation protein-based high performance silk fibers for genetically engineered ballistic materials (1450)
- Refine multi-spectral materials for personnel camouflage (1855)
- Develop a protective goggle to provide maximum protection from multi-line lasers while maintaining optimal visual transmittance (755)
- Investigate feasibility of technology insertion of new carbonaceous fiber into existing nylon-cotton protective uniform fabrics to impart durable flame resistance; demonstrate electrically heated handwear by optimizing design of the controller/liner (1380)
- Integrate optimized, selectively permeable membranes and flame resistant permeable fabrics into lightweight, highly moisture vapor permeable textile systems for chemical protection (947)
- Provide modeling, simulation, and analysis supporting clothing and textile development to quantify and maximize the viability/capability of proposed systems (1800)
- Develop prototype lightweight, modular microclimate cooling system; apply motion analysis techniques to analyze interface between soldier and soldier's clothing/equipment; and evaluate optimal designs for biomechanically efficient prototype footwear and develop protocol for military field testing (1478)

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FY 1997 Planned Program:

- Conduct integration of optimized small arms protective technologies and fragmentation protective technologies and evaluate against multiple ballistic threat requirements; demonstrate improved material system for aircrew armor (2720)
- Evaluate ballistic properties of high-performance genetically engineered silk; produce prototype bioengineered ceramic materials (1585)
- Evaluate prototype materials for multispectral camouflage protection for personnel (1875)
- Develop and incorporate non-linear optical materials in the development/performance of tunable laser eye protection (790)
- Establish DoD-wide flame/thermal hazard assessment scale, standardized flame/thermal protocol and material property data base; fabricate a reversible camouflage uniform using stitchless seaming technology (1525)
- Incorporate novel, semi-permeable membranes into lightweight protective garments and evaluate for durability and reduced physiological burden; evaluate the effectiveness of reactive technologies for the detoxification of multiple warfare agents in textiles (985)
- Integrate into the Army Research Laboratory's (ARL) Computer Man Wound Ballistic Vulnerability model, methodologies including integrated soldier system computer aided design techniques, simulation and assessment of musculoskeletal trauma due to missile penetration, and computer models describing anatomical differences due to anthropometry and posture (1900)
- Conduct field investigation of soldiers performing combat-related activities to validate laboratory findings of the interface between soldier and soldier clothing/equipment and perform lab-based biomechanical evaluations on prototype footwear as well as small scale military field tests to obtain user feedback and verifications of evaluations on footwear characteristics; demonstrate a battery operated microclimate cooling system weighing less than ten pounds (1506)

Project AH99- Joint Service Food/System Technology: This DoD program addresses the food and food system technologies to support all the military Services, Special Operations Command, and the Defense Logistics Agency. Thrust areas include the exploratory development of combat rations, packaging, field food service equipment and combat food service systems, all of which enhance the survivability, sustainability, and supportability of the Armed Forces by ensuring optimal nutritional intake to maximize cognitive and physical performance on the battlefield.

FY 1994 Accomplishments:

- Developed experimental hydrogen suppression compounds that lower hydrogen produced by standard heater as much as 80%; demonstrated capability of lowering end point of diesel fuel from 642°F to 428°F (273)
- Completed evaluation of prototype Modular Appliance Technologies, Centralized Heating concept for field kitchens; developed concept for the Nonpowered Instant Water Heater for providing a supply of hot water for field sanitation that is heat driven instead of engine/motor driven (160)
- Developed and obtained Navy approval of shipboard food service equipment management concept alternatives (75)
- Completed market survey for oxygen scavenging packaging material and accelerated storage test, demonstrated efficiency of intrinsic chemical marker to predict thermo stability of packaged ration components; demonstrated rapid assay kit for Listeria (2447)
- Completed studies on reduction of hydrogen gas generation from water activated chemical heaters for self heating rations; initiated cost/benefit analysis for self heating rations (459)

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- Established glass transition model for combat rations that will reduce heat sensitivity of food components; determined bioavailability efficiency of carbohydrates in pouched bread stored in high heat environment (418)
- Conducted limited field test of a carbohydrate beverage, formulated to enhance endurance; demonstrated, non-invasively, conversion to glycogen of ingested carbohydrate; demonstrated extended, elevated, level of saliva caffeine from innovatively formulated caffeine bar, and confirmed increase in cognitive performance when caffeine is ingested (755)

FY 1995 Planned Program:

- Complete laboratory testing of microbiological parameters of temperature stressed fresh/frozen rations; demonstrate Self Heating Group Ration (transition to demonstration/validation); conduct laboratory evaluations of mobility enhancing ration components; investigate commercial irradiated food products for insertion into operational rations; investigate renewability, utilization, cost and consumer acceptability of marine products for operational rations (1419)
- Conceptualize and analyze feasibility of producing a flexible, horizontal form-fill-seal tray, similar to commercially produced, that could be adaptable for self-heating rations; investigate spray-on coated barriers for food packaging; fabricate prototype food package which actively absorbs oxygen to extend storage life (765)
- Develop improved stability in starch and protein based foods; investigate intrinsic chemical marker/microbiological validation of ohmic heating; investigate glass coated materials as primary packaging material for field rations; complete improved shelf stable, high heat ration (1026)
- Investigate natural food constituents, from complex carbohydrates, chain triglycerides, caffeine, phosphatidyl choline and other natural micronutrients to promote significant positive enhancements to mental acuity and physical endurance; incorporate components into consumer acceptable ration items for use in limited field evaluations (708)
- Initiate experimental development of Nonflammable Ration Heater; develop and test catalytic vaporizers for nonpowered field burners; initiate development of nonpowered heat driven adsorption refrigeration based on ammoniated complex compounds (449)
- Conduct trade-off/cost analyses for technology insertions for the Mobile Kitchen Trailer; initiate development of Thermoelectric Generator for Field Burners. Investigate equipment aspects of food packaging waste reduction; complete and transition to Navy an improved system for shipboard food service equipment management (726)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (109)

FY 1996 Planned Program:

- Apply selected coatings to primary and secondary food packaging materials; compare to requirements for current primary barrier; evaluate feasibility of a multi-service source reduction and recycling initiative featured as a field waste compactor/pulper (385)
- Complete analysis of nutritional labeling system; conduct small-scale field testing of mobility enhancing ration components; conduct packaging analysis for the Self Heating Group Ration safety hazard classification; conduct limited user testing of high barrier polymeric tray; continue to investigate applicability of high potential technology insertions of irradiated food items into operational rations; determine stability and acceptability of marine products (1915)
- Complete technology demonstrations/field testing of improved high heat, shelf stable ration, transition to advanced development; develop glass coated packaging material for use in laboratory testing; complete accelerated long term testing of selected food components; conduct shelf-life studies of multiple barrier processed marine products (355)

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- Complete selection of constituents and reliably and acceptably formulate ration components to ensure enhanced performance under different combat situations; produce large quantities of rations to support field testing under varied tactical conditions (283)
- Identify and optimize complex carbohydrate components for metabolic release during periods of high demands; conduct limited, accelerated shelf studies and small scale user studies to evaluate potential for decrease in metabolic release functionality over time and in various temperature scenarios (177)
- Identify intrinsic chemical markers required for optimizing thermal processing of rations; evaluate emerging microbial issues for safety assessment of temperature-abused foods (530)
- Complete development of Nonflammable Ration Heater; complete experimental development of catalytic-vaporizing burners; design and fabricate 8 cubic foot experimental heat driven (direct fire) adsorption refrigerator; design and fabricate experimental Nonpowered Instant Water Heater (962)
- Develop and test a diesel burner for a commercial absorption refrigerator; test and evaluate prototype Thermoelectric Generator for Field Burners and transition technology into the Powered Multifuel Burner; transition food and packaging waste handling system to Demonstration/Validation for field testing (585)
- Establish operating capacity requirements for modular feeding for Navy construction battalions; conduct supportability analysis of food service equipment life cycle costs to identify Operating and Support (O&S) cost savings in ship renovations/future ship designs (217)

FY 1997 Planned Program:

- Conduct logistical analysis of potential selected high value irradiated food products; continue to develop new food products for technology transition, under the Family of Operational Rations, which provides maximum shelf stability and acceptability for technology insertion (1952)
- Transition new formulations and processing techniques for packaging and palletization of highly stabilized rations to procurement (530)
- Establish quantifiable measurements criteria and measuring techniques for determining levels of improvements to mental acuity and physical endurance; conduct a large scale field evaluation of consumer acceptable rations with effective constituents, to demonstrate performance enhancement; identify potential components for technology insertion (595)
- Fabricate a prototype automated, user friendly, instrumental prediction and assessment of shelf life of rations/food, particularly at elevated temperatures (50)
- Identify a system to monitor and adjust electrolytes used to supplement rations to assure maximum nutrient bioavailability; exploit capability to non-invasively measure physiological indices when evaluating nutrients for performance enhancements (176)
- Select and incorporate neurotransmitter precursors in ration components or as supplements for anti-stress; evaluate and exploit phosphatidyl choline utilization for enhanced neuromuscular activities and identify approaches to supplement rations with this neurotransmitter (278)
- Initiate investigation of an advanced fuel conversion process to reform diesel fuel into permanent gases (including hydrogen) for operation of gas fired appliances in a field kitchen powered by a fuel cell; design and fabricate 16 cubic foot thermal fluid driven adsorption refrigerator (1031)
- Complete experimental development of diesel fired absorption refrigerator; initiate concept development of Forward Fast Food Service (329)
- Evaluate field prototypes of modular feeding systems for widely dispersed Navy construction battalions; design Navy food service equipment system life cycle data base that will allow simulations to project cost savings resulting from varying ship food service designs (626)

Project DJ10 - Combat Rations Quality Enhancement: This project involves development of technologies for quantifying food quality in combat rations and other emergency feeding situations to enhance consumer acceptance. Parameters affecting food quality, including interrelationships among raw materials, processing,

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packaging, and storage, will be determined and analytical techniques for quantification will be developed. Innovative processing methods (ohmic heating and combination preservation processes) will be investigated. Optimal raw material processing techniques and packaging systems will be selected to minimize deteriorative changes in foods and maximize the deliverable quality of subsistence to the user community. It also involves the use of novel electric and magnetic field technologies to pasteurize chilled items; the efficacy and practicality of cold pasteurization will be explored. Work in this project will be completed in FY 1996.

FY 1994 Accomplishments:
- Evaluated initial samples of shelf stable ration components produced using high pressure preservation technologies and pulsed electric fields; processing parameters for safety assurance were established for selected items to assure sensory quality (2000)
- Correlation of sensory quality with in-line optical/laser sensors was completed; mathematical modeling of the thermal processes for combination entree ration components was completed and transitioned to manufacturing technology programs (2020)

FY 1995 Planned Program:
- Identify and characterize microbial enzymes leading to ration quality losses; investigate free radical formation during processing and identify effects on ration quality; correlate military consumer perception of quality with chemical and physical measurements (813)
- Award research contracts to demonstrate and develop ration components produced by non-thermal high pressure and/or pulsed electric fields (1849)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (57)

FY 1996 Planned Program:
- Complete identification and characterization of factors affecting ration quality and identify test methods for quantifying the quality of combat rations (1263)

FY 1997 Planned Program: Project not funded

Project D283 - Airdrop Advanced Technology: This project involves exploratory development to enhance personnel and cargo airdrop capabilities. Areas of emphasis include parachute technology for improved performance, precision offset aerial delivery, soft landing system development, airdrop simulation, and high speed airdrop systems technologies. Efforts will result in increased personnel safety and reduced personnel, aircraft, and cargo vulnerability.

FY 1994 Accomplishments:
- Developed a numerical model to predict the opening process and descent performance of parachute systems; applied the model design of decelerators to the Bosnia-Herzegovina airdrop operation (400)
- Developed and tested a measurement device to monitor the motion of individual canopies in a parachute cluster for understanding the unsteady aerodynamics of a parachute cluster opening when heavy loads are airdropped (300)
- Developed an airdrop system computer program to predict the descent path of parachutes for both personnel and cargo airdrop operations for preplanning missions (343)

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- Developed and validated an apparatus for measuring the effects of electrostatic charge on parachute opening during wind tunnel testing (360)
- Completed development of computer software relating human factors in airdrop operations in order to minimize stress and prevent injuries (340)
- Constructed and validated a physical testing apparatus to determine the stress/strain relationship of parachute fabrics to reduce parachute failure during airdrop operations (253)

FY 1995 Planned Program:

- Identify experimental methods for measuring parachute performance to verify computation of dynamic opening performance, thus improving reliability of designs for low altitude airdrop systems (223)
- Initiate experimental and theoretical analysis of the opening of small deployable gliding wing decelerators for use at greater altitudes and lateral offset to reduce vulnerability (243)
- Complete systems analysis to improve effectiveness and reliability of high-altitude, offset air delivery of supplies and heavy combat equipment (318)
- Apply computational fluid dynamics, trajectory analysis, advanced concepts and improved experimental techniques to enhance low-altitude parachute performance; complete study of the influence of electrostatic charge on parachute opening to reduce the risk of airdrop system failure (634)
- Complete vulnerability assessment of high altitude cargo air delivery (183)
- Complete analytical models for evaluating advanced airdrop concepts; develop a model of human performance/biomechanics to improve parachutist safety (283)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (40)

FY 1996 Planned Program:

- Develop experimental methods for measuring parachute performance to validate parachute opening model to provide reliable designs for low altitude airdrop systems (264)
- Conduct experimental and theoretical analysis of the opening dynamics of large gliding wing decelerators to deploy at higher altitudes and greater lateral distances to reduce aircraft vulnerability (250)
- Initiate analysis and experiments on the aerodynamics, guidance and control of flexible gliding wings to characterize their use in airdrop systems (200)
- Continue applying computational fluid dynamics, trajectory analysis, advanced concepts and improved experimental techniques to enhance low altitude parachute performance (602)
- Determine the dynamic characteristics of parachute materials that potentially could reduce the risk of airdrop system failure (130)
- Identify parameters for developing a model of human performance/biomechanics to improve parachutist's safety (100)

FY 1997 Planned Program:

- Complete development of experimental methods for measuring parachute performance to validate parachute opening model to provide reliable designs for high speed low altitude airdrop systems (250)
- Complete experimental and theoretical analysis of the opening of large deployable gliding wing decelerators for use at higher altitudes and greater lateral distances to reduce aircraft vulnerability (279)

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- Conduct analysis and experiments on aerodynamics, guidance and control of flexible gliding wings (250)
- Using the results of computational fluid dynamics and trajectory analyses, determine characteristics/factors that will enhance low altitude, parachute performance (602)
- Analyze the dynamic behavior of parachute materials to reduce the risk of airdrop system failure (149)
- Develop a model of human performance/biomechanics to improve parachutist's safety (150)

Project A427 - Tactical Shelters-Exploratory Development: This project addresses requirements for transportable maintenance tentage and soldier quality-of-life tentage technologies, both identified in Operation Desert Storm (ODS) as required improvements. Thrusts focus on tentage structures and lightweight materials for advanced pressure-stabilized rib tentage, and improved shelter habitability through ventilation modeling/advanced designs. Exploited technologies will significantly increase mobility through reduction of tentage weight and shelter erect/strike times, increase service life, enhance sustainability, and reduce operating and support (O&S) costs. Work in this project is complete in FY 95.

FY 1994 Accomplishments:
- Designed quick-erect, lightweight night maintenance shelter brassboard using advanced high-pressure airbeam supports (1354)
- Demonstrated full-scale airbeam technology (1228)

FY 1995 Planned Program:
- Conduct technical testing of the Large Area Night Maintenance Shelter support module (1230)
- Complete required redesign; initiate full scale fabrication of complete Large Area Night Maintenance Shelter (1112)
- Optimize airbeam technology fabrication techniques (500)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	31417	31825	24633	24507
Appropriated Value	31417	34110		
Adjustments to Appropriated Value (Total PE)	-945			
a. SBIR/STTR decrement (-173)				
b. Reprogramming (-772)				
Current President's Budget Submit	30472	34110	28036	27530

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

DATE: February 1995

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602787A Medical Technology

	COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	94054	94063	56658	56973	58223	60192	59325	59593	Continuing	Continuing
A825	Combat Maxillofacial Injury	1314	997	1058	1057	1106	1170	1160	1190	Continuing	Continuing
A863	Battlefield Surgical Tissue Replacement	0	4933	0	0	0	0	0	0	0	4933
A864	Epidermolysis Bullosa	0	986	0	0	0	0	0	0	0	986
A870	DoD Medical Defense Against Infectious Diseases	25097	24763	24889	25450	26422	26964	26509	25933	Continuing	Continuing
A871	Medical Biological Defense-Exploratory Development *	14838	14454	0	0	0	0	0	0	0	29292
D873	HIV Exploratory Research	2911	3102	2879	3019	3158	3358	3361	3446	Continuing	Continuing
A874	Combat Casualty Care Technology	10326	11978	12249	11142	10150	10316	10154	10416	Continuing	Continuing
A875	Medical Chemical Defense-Exploratory Development *	15535	14985	0	0	0	0	0	0	0	30520
A878	Health Hazards of Military Materiel	9121	7986	7181	7509	8003	8533	8490	8708	Continuing	Continuing
A879	Medical Factors Enhancing Soldier Effectiveness	8711	9879	8402	8796	9384	9851	9651	9900	Continuing	Continuing
A881	Laser Burn Research	1969	0	0	0	0	0	0	0	0	1969
A882	Environmental Medical Unit	295	0	0	0	0	0	0	0	0	295
A883	Post-Polio Syndrome	984	0	0	0	0	0	0	0	0	984
A884	Hypoglycemia	984	0	0	0	0	0	0	0	0	984
A885	Madigan ENT Project	1969	0	0	0	0	0	0	0	0	1969

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

* Starting in FY 1996, funding has been consolidated into PE 0602384BP in accordance with P.L. 103-160.

A. **Mission Description and Budget Item Justification**: This program element funds exploratory development in Department of Defense (DoD) medical defense against chemical agents, medical defense against biological threats, medical protection against naturally occurring diseases of military importance, and combat dentistry, as well as exploratory development for Department of Army care of combat casualties, health hazard assessment of military materiel, and medical factors enhancing soldier effectiveness. Starting in FY 1996, funding for chemical and biological defense medical research and development efforts (projects A871 and A875) have been consolidated into PE 0602384BP in accordance with P.L. 103-160. The primary goal of medical research and development is to sustain the medical technology superiority to improve the protection and survivability of U.S. forces on the conventional battlefields as well as in potential areas of low intensity conflict and military operations short of war. This program element is the core DoD technology base to develop methods and materials for: medical chemical defense in the areas of antidotes, drug treatments, medical protection against chemical agents, personnel and casualty decontamination, medical management of chemical casualties, and combat effectiveness and sustainability; medical biological defense and infectious disease prevention and treatment including vaccines, prophylactic and therapeutic drugs, insect repellents, and methods of diagnosis and identification of biological warfare threats or naturally occurring infectious diseases; prevention and treatment of combat maxillofacial (face and neck) injuries, and essential dental treatment on the battlefield; combat casualty care of trauma and burns due to weapons, organ system survival, shock resulting from blood loss and infection, blood preservation and potential blood substitutes for battlefield care; assessment of the health hazards of military materiel, and the sustainment or enhancement of soldier performance. The work in this Program Element is consistent with the resource constrained Army Science and Technology Master Plan, Army force modernization plans, and Project Reliance. This program is managed primarily by the US Army Medical Research and Materiel Command. Efforts in this Program Element include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.

Project A825-Combat Maxillofacial Injury: This project has as its major thrusts exploratory development of new/improved methods and material for rapid simplified treatment of face and neck wounds and provision of field dental treatment.

FY 1994 Accomplishments:
- Began studies to enhance the stability of critical dental materials by improving composition and packaging. (563)
- Continued the shelf life study of perishable dental biomaterials. (415)
- Identified and tested novel local anesthetics for treatment of pain far-forward. (336)

FY 1995 Planned Program:
- Continue development of hemostatic agent to control osseous bleeding from far-forward maxillofacial injury. (592)
- Apply 3-D data to the custom design and fabrication of splints and prostheses needed for management of combat craniofacial injuries. (393)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (12)

FY 1996 Planned Program:
- Determine the efficacy of osteogenin (bone growth material) in appropriate fracture model. (240)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

- Investigate the effects of the combination of osteogenin and other growth factors in *in vivo* models of bone injury. (333)
- Transition most promising of novel biopolymers (for release and degradation of growth factors) to exploratory development. (485)

FY 1997 Planned Program:
- Identify efficacy of computer aided design/computer aided manufacturing (CAD/CAM) in determining correct surface area dimensions of various body surfaces, especially major traumatic injuries. (353)
- Determine applicability and efficacy of biodegradable bone screws in appropriate experimental models. (200)
- Complete exploratory development of novel bone wax product, effective in arresting hemorrhage from bone. (329)
- Incorporate novel algorithms into current CAD/CAM surface scanning devices for developing novel compression bandages, implants, splints, and prostheses. (175)

Project A863-Battlefield Surgical Tissue Replacement: By Congressional direction, the purpose of this project is to initiate research on surgical tissue replacement.

FY 1994 Accomplishments: Project not funded.

FY 1995 Planned Program:
- Award competitive contracts/grants to initiate research on surgical tissue replacement in accordance with established defense acquisition procedures. (4829)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (104)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A864-Epidermolysis Bullosa: By Congressional direction, the purpose of this project is to initiate research on epidermolysis bullosa.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Award a competitive contract/grant to initiate research on epidermolysis bullosa in accordance with established defense acquisition procedures. (965)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (21)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

Project A870-DoD Medical Defense Against Infectious Disease: This project supports development of medical countermeasures to naturally occurring infectious disease, a significant threat to forces deployed outside the United States. These countermeasures will protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations.

FY 1994 Accomplishments:

- Evaluated immune responses to diarrheal infections required for producing protective immunity; evaluated feasibility and stability of E. coli-Shigella sonnei hybrid as a potential vaccine against bacterial diarrheal disease. (3730)
- Determined molecular properties of anti-idiotype monoclonal antibodies for use as candidate malaria vaccines. (3048)
- Evaluated extracts of traditional African drugs as potential anti-malarials; evaluated potential of drug resistant reversing agents in restoring utility of standard antimalarial drugs against drug resistant strains of malaria. (4683)
- Evaluated new techniques for: far-forward diagnosis, recognition of emerging infections, assays for rickettsial disease, and identification of infected disease carrying insects; characterized global variation of campylobacter species to select vaccine components. (7155)
- Evaluated purified dengue virus components as subunit dengue fever vaccines; identified hemorrhagic fever virus components as potential vaccine components; selected candidate vaccines against group-B meningitis and gonorrhea for microencapsulation. (6481)

FY 1995 Planned Program:

- Evaluate in animals vaccine induced mucosal immunity to shigella, Enterotoxigenic Escherichia coli, and campylobacter diarrheal disease; evaluate safety and efficacy in animal models of multivalent vaccine against hepatitis A and B. (6364)
- Evaluate safety and efficacy of malaria vaccine PfSSP2 against falciparum malaria in primates; determine the ability of purified dengue virus proteins to protect animals from lethal dengue virus challenge. (7115)
- Evaluate active principals of African traditional medicines against multi drug-resistant malaria and as drug resistance reversing agents; isolate and determine chemical structures of active antimalarial principals of African traditional medicines. (4613)
- Evaluate threat posed to deployed forces by hepatitis C and E, as well as drug resistant scrub typhus and drug resistant malarias; evaluate immune responses important to protection against group B meningitis. (3615)
- Prepare and evaluate in an animal model enhanced formulations of gonorrhea vaccines employing microspheres; explore new vaccine candidates using genetically engineered tick-borne encephalitis and hemorrhagic fever virus components. (3055)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (1)

FY 1996 Planned Program:

- Evaluate safety and efficacy of live Shigella sonnei vaccine strains in animal models. (4961)
- Evaluate safety and efficacy of liposomal pentamidine (antileishmanial drug) and artemisia analog (antimalarial drug) in animal models. (3938)
- Evaluate safety and efficacy of blood stage P. vivax malaria vaccine candidates in animal models to select candidate for transition to clinical trials. (5776)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

- Evaluate killed and live attenuated dengue virus vaccine candidates for safety and efficacy in animal models to select candidate for transition to clinical trials; determine safety and efficacy of candidate in animal model of an insect repellent to replace DEET (4963)
- Evaluate safety and efficacy of group B meningitis vaccine in animal models to transition to clinical trials; select technology for infectious disease forward diagnostic kits. (5251)

FY 1997 Planned Program:

- Complete safety and efficacy of Shigella flexneri vaccine candidates in animal models; determine whether there is natural immunity to hepatitis E following infection. (5066)
- Evaluate candidate malaria drug resistance modulators capable of reversing parasite resistance to standard antimalarial drugs to select candidate for transition to clinical trials. (4158)
- Evaluate gonorrhea vaccine candidates for safety and efficacy to select candidate for transition to clinical trials; evaluate in animal models safety and efficacy of combined vaccine against common bacteria causing septic shock in wound infections. (5431)
- Evaluate safety and efficacy of candidate blood stage and infective stage P. vivax malaria vaccines to select candidate for transition to clinical trials. (5542)
- Evaluate candidate dengue vaccines to select best technology for transition to advanced development; continue capability to identify and assess threat to deployed forces of high hazard viral diseases. (5253)

Project A871-Medical Biological Defense/Exploratory Development: This project funds exploratory research on the development of vaccines and drugs to provide an effective medical defense against validated biological threat agents including bacteria, toxins, viruses and other agents of biological origin. By employing biotechnology, medical systems will be designed to rapidly identify, diagnose, prevent and treat disease due to exposure to biological threat agents.

FY 1994 Accomplishments:

- Utilized animal models to evaluate the efficacy of bio-engineered vaccines against bacterial agents. (1695)
- Evaluated procedures for preparing viral bio-engineered candidate vaccines to Venezuelan equine encephalitis, and formulated strategies for bio-engineering vaccines to other viral threat agents. (442)
- Evaluated pharmacologic agents for prophylaxis and therapy of biological toxin intoxication. (9171)
- Tested the initial prototype of a field diagnostic system, and utilized emerging biotechnology for improved methods in analyzing biological threat agents in the field. (2903)
- Formulated specific intervention strategies for biological threat agents based on acquired paradigms. (627)

FY 1995 Planned Program:

- Conduct exploratory research on the development of synthetic and bio-engineered vaccines to *Brucella* sp., and utilize the protocols to develop engineered vaccines to other bacterial threat agents. (2730)
- Determine the safety and efficacy of candidate vaccines for viral agents. (524)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

- Determine the safety and efficacy of candidate drugs for the treatment of biological toxins such as botulinium toxin. (9781)
- Evaluate laboratory preparations of candidate biological reagents for use in confirmation diagnostic kits; develop the best reagents for use in confirmatory kits. (920)
- Develop specific intervention strategies for biological threat agents. (306)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (193)

FY 1996 Planned Program: Project moved to DoD PE 0602384BP, project number D71.

FY 1997 Planned Program: Project moved to DoD PE 0602384BP, project number D71

Project A873-HIV Exploratory Research: This project provides for exploratory development of improved diagnostics, epidemiology, candidate immunogens, promising drugs and behavioral modification for prevention and treatment of HIV. Main efforts include developing experimental models of disease, preparation of new vaccine candidates, improved diagnosis of disease and risk assessment. Current policy prohibits antibody positive service members from OCONUS deployment. A safe and effective vaccine for prevention of infection and intervention techniques will permit all service members to become worldwide deployable.

FY 1994 Accomplishments:
- Characterized effects of chemotherapeutic agents on the replication of HIV virus in an *in vitro* system. (699)
- Defined geographical areas of military importance with high incidence of disease. (630)
- Described the effects of early infection on white blood cells in an animal model. (340)
- Evaluated candidate vaccines which prevent infection or enhance immune responses against HIV infection. (315)
- Characterized the clinical, immunologic and virologic features of the natural history of HIV disease (926)

FY 1995 Planned Program:
- Define the immune response, both humoral and cellular, after immunization of animals with HIV antigens. (898)
- Evaluate worldwide variability in HIV genome. (632)
- Characterize effects of chemotherapeutic agents *in vitro* on the replication of HIV virus. (665)
- Develop quantitative measures of viral growth to assist evaluation of candidate vaccines and treatments (522)
- Evaluate HIV variability in serial blood samples. (320)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (65)

FY 1996 Planned Program:
- Conduct vaccination/challenge studies in non-human primates. (986)
- Improve vaccine candidate diversification to increase coverage of global variants of HIV. (500)
- Develop a therapeutic vaccine product (DNA vaccines). (250)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

- Evaluate mucosal immunity induction (proteosome, microspheres). (500)
- Conduct assay for humoral and cellular correlates of immunity, diagnostic immunotyping across HIV-1 isolates. (643)

FY 1997 Planned Program:
- Conduct vaccination/challenge studies in an animal model. (500)
- Conduct assessment studies on rapid vs. slow disease progression. (500)
- Conduct assessment studies on transmission events for candidate HIV-1 preventive vaccines. (500)
- Improve vaccine candidate diversification to increase coverage of global variants. (1519)

Project A874-Combat Casualty Care Technology: 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 short of war. This project addresses investigation of the treatments for weapons-induced trauma and burns, and shock due to blood loss. It also funds technologies for blood substitutes and blood preservation.

FY 1994 Accomplishments:
- Determined the effect of head trauma (alone, and in combination with other physiological insults such as hemorrhage) on cardiodynamic responses to traumatic injury; evaluated intraosseous infusion device. (1317)
- Continued efficacy studies for cytokine antibody and inhibitor therapy; assessed the effects of growth factors and skin substitutes on wound healing in thermally injured patients. (5094)
- Initiated studies that involve innovative therapies such as lazeriods. (365)
- Performed peripheral nerve and bone regeneration studies utilizing electrical current; improved techniques of burn wound management to include topical agents, hormones, and skin substitutes. (3524)
- Developed new technologies for cold sterilization to support field medical needs; determined feasibility of use of photovoltaic cells to power medical equipment in the field. (26)

FY 1995 Planned Program:
- Determine vital organ (brain, heart, lung) functional responses to traumatic brain injury combined with hemorrhage; produce purified hemoglobin and chemically modified hemoglobins for evaluation as blood substitutes. (1539)
- Continue studies on the slowing of a casualty's metabolic rate (e.g., with the use of recombinant hibernation induction trigger molecules) as a stabilization therapy in the initial treatment of traumatic injury. (5088)
- Identify and test innovative soft tissue trauma therapies such as lazeriods. (654)
- Improve techniques of burn wound management to include topical agents, hormones, and skin substitutes. (4590)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (107)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

FY 1996 Planned Program:

- Resume production of standard stroma-free, cross-linked human hemoglobin solution, for comparison with various commercial hemoglobin preparations. (2838)
- Determine the efficacy and safety of red cells stored for 8 weeks in standard refrigeration; prepare for transition to advanced development. (3081)
- Determine the efficacy of immune therapy (antibodies to lipopolysaccharide) in the treatment of septic shock, using appropriate experimental models. (3019)
- Test prototype, non-invasive physiological sensors (deep tissue pH, blood flow, tissue oxygenation) in appropriate experimental models. (1418)
- Identify the limits of near infrared or infrared penetration through intact skin and into various body tissues, as background for non-invasive sensor development and use. (1893)

FY 1997 Planned Program:

- Determine safety of immune therapy in the treatment of septic shock. (2682)
- Identify the range of uses for local hemostatic agents in the treatment of extremity hemorrhage following tissue trauma. (3081)
- Determine the usefulness of limitations of partial tournication as an adjunct therapy in the treatment of extremity hemorrhage. (1828)
- Identify the benefits of hibernation drugs in the treatment of massive hemorrhage. (1950)
- Identify the utility of hypothermia in the treatment of massive hemorrhage or tissue trauma. (1601)

Project A875-Medical Chemical Defense-Exploratory Development: This project funds medical chemical defense exploratory development, and emphasizes the prevention of chemical casualties through application of pharmaceuticals for prevention and treatment of the toxic effects of nerve, blister, respiratory, and blood agents. This project supports exploratory development of prophylaxes, pretreatment, antidotes, decontaminants, and therapeutic compounds that will counteract the lethal, physical, and behavioral toxicity of chemical agents. It also supports development of medical chemical defense material that insures adequate patient care, field resuscitation, and patient procedures.

FY 1994 Accomplishments:

- Characterized and validated countermeasures against sulfur mustard; generated monoclonal antibodies to sulfur mustard; investigated reactive components for topical skin protectant. (7151)
- Characterized and validated countermeasures to cyanide. (2930)
- Characterized and validated countermeasures to nerve agent-induced seizures and pathology; refined methods to detect agents in biological fluids. (2975)
- Characterized and validated catalytic and immunological scavengers for nerve agents; employed biotechnological approaches to development of scavengers. (1645)
- Characterized and validated decontamination, diagnostic, prognostic, and treatment procedures directly applicable to patient management. (834)

FY 1995 Planned Program:

- Investigate medical countermeasures against sulfur mustard; generate monoclonal antibodies to sulfur mustard; investigate reactive components for topical skin protectant. (6753)
- Identify medical countermeasures to cyanide; investigate feasibility of catalytic and immunological scavengers for cyanide. (2111)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

- Identify medical countermeasures to nerve agent-induced seizures and pathology; refine methods to detect agents in biological fluids. (3127)
- Explore potential catalytic and immunological scavengers for nerve agents; employ biotechnological approaches to development of scavengers. (1935)
- Validate decontamination, diagnostic, prognostic, and treatment procedures directly applicable to patient management. (955)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (104)

FY 1996 Planned Program: Project moved to DoD PE 0602384BP, project number D75.

FY 1997 Planned Program: Project moved to DoD PE 0602384BP, project number D75.

Project A878-Health Hazards of Military Materiel: This project focuses on protecting soldiers from health hazards associated with their own materiel and operational environments. Emphasis is on identification of health hazards inherent to the engineering design and operational use of equipment, systems and materiel used in Army combat operations and training. Specific hazards include: steady-state acoustical energy, repeated impact jolt and vibration stress from operation of combat vehicles and aircraft; blast overpressure and impulse noise generated by firing weapons systems; toxic chemical hazards associated with Army materiel such as gun and rocket munitions and their combustion byproducts; non-ionizing radiation directed energy sources (laser and microwave); and environmental stressors (e.g. heat, cold, terrestrial altitude). Specific medical 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.

FY 1994 Accomplishments:
- Characterized suppression of immune function during high-intensity military training. (1149)
- Characterized factors predisposing military recruits to heat-induced illness. (192)
- Developed model to assess the visual performance decrements associated with laser exposure. (2234)
- Determined criteria for allowable concentrations of chemical contaminant in field potable water. (1961)
- Determined validated tolerance limits for freefield mortar blast overpressure. (3585)

FY 1995 Planned Program:
- Characterize health hazards of prototype electro-optic displays. (990)
- Characterize thermoregulatory responses of female soldiers to heat stress. (164)
- Determine permissible laser exposure limits for subnanosecond exposure. (1926)
- Characterize health hazards of developmental smoke/obscurant munitions. (1691)
- Validate model to predict pulmonary injury from blast overpressure. (3090)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (125)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

FY 1996 Planned Program:

- Determine guidelines to minimize eye-strain with extended use of vision enhancement devices. (760)
- Publish field guide to prevent environmental injury in hot, wet, tropical environments. (1272)
- Develop safe exposure criteria for frequency agile lasers. (1477)
- Characterize health risks from combustion products of new artillery system. (1297)
- Determine validated tolerance limits for shoulder-fired anti-armor weapons fired from enclosures. (2375)

FY 1997 Planned Program:

- Develop chemoprophylaxis to prevent spatial disorientation. (946)
- Demonstrate effectiveness of individual soldier medical monitoring system in preventing heat and cold injury. (157)
- Characterize the health hazards of electromagnetic pulse from prototype electro-magnetic weapon systems. (1840)
- Characterize effects of likely concurrent exposure to multiple chemicals from Army systems. (1615)
- Develop recommended safe exposure criteria for repeated impulse noise in reverberant enclosures. (2951)

Project A879-Medical Factors Enhancing Soldier Effectiveness: This project focuses on sustaining warfighting capability by preventing health and performance degradation in the military environment. Emphasis is on identification of health hazards inherent to the engineering design and operational use of equipment, systems and materiel used in Army combat operations and training. Specific hazards include: steady-state acoustical energy, repeated impact jolt and vibration stress from operation of combat vehicles and aircraft; blast overpressure and impulse noise generated by firing weapons systems; toxic chemical hazards associated with Army materiel such as gun and rocket munitions and their combustion byproducts; non-ionizing radiation directed energy sources (laser and microwave); and environmental stressors (e.g. heat, cold, terrestrial altitude). Specific medical research tasks include characterizing performance decrements produced by environmental stressors; developing strategies to overcome these decrements, including training, nutrition, and pharmacological solutions; delineating exposure thresholds for illness or injury; identifying exposure thresholds for performance degradation; establishing biomedical databases to support sustainment criteria; and developing and validating models for hazard assessment, injury prediction, and health and performance protection.

FY 1994 Accomplishments:

- Evaluated the use of melatonin and bright light for facilitating the transition from day to night operations. (6194)
- Evaluated the use of erythropoietin for achieving pre-exposure acclimatization to high altitude. (2517)

FY 1995 Planned Program:

- Identify biomedical and mission factors increasing risk of thermal injury and performance decrements. (6999)
- Examine gender related differences in physical performance during basic military training. (2847)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (33)

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BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

FY 1996 Planned Program:
- Identify biomedical and mission factors affecting work and performance at high terrestrial altitudes. (5974)
- Demonstrate behavioral and materiel means to reduce musculoskeletal injuries during military operations (2428)

FY 1997 Planned Program:
- Determine the physiological limits to performance of key soldier occupational tasks. (6254)
- Demonstrate behavioral and pharmacological strategies to enhance thermoregulation in hot and cold environments. (2542)

Project A881-Laser Burn Research: By Congressional direction, the purpose of this project is to support advanced laser burn treatment diagnostics and therapeutic research.

FY 1994 Accomplishments:
- Identified advanced laser burn treatment diagnostics and therapeutic strategies. (1969)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A882-Environmental Medical Unit: By Congressional direction, the purpose of this project is to initiate research on the health effects of exposure to low levels of hazardous chemicals, including chemical warfare agents, especially among persons who served on active duty in Southwest Asia during the Persian Gulf War.

FY 1994 Accomplishments:
- Awarded a competitive contract/grant to initiate research on health effects of exposure to low levels of hazardous chemicals, in accordance with established defense acquisition procedures. (295)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

Project A883-Post-Polio Syndrome: By Congressional direction, the purpose of this project is to initiate research on models of musculoskeletal injury.

FY 1994 Accomplishments:
- Awarded a competitive contract/grant to initiate research on models of musculoskeletal injury in accordance with established defense acquisition procedures. (984)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A884-Hypoglycemia: By Congressional direction, the purpose of this project is to develop and test new forms of insulin.

FY 1994 Accomplishments:
- Awarded a competitive contract/grant to initiate research for the development and testing of new insulin derivatives in accordance with established defense acquisition procedures. (984)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A885-Madigan ENT Project: By Congressional direction, the purpose of this project is to develop virtual simulation for training in trauma care and surgical procedures.

FY 1994 Accomplishments:
- Identified promising technologies. (1969)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602787A Medical Technology

FY 1997 Planned Program: Project not funded

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	94761	87529	72436	73948
Appropriated Value	94761	94063		
Adjustments to Appropriated Value	-707			
a. SBIR/STTR (-459)				
b. Reprogramming (-248)				
Current President's Budget Submit	94054	94063	56658	56973

Changes to FY 1996/FY 1997: Funding for chemical and biological defense medical research and development efforts (projects A871 and A875) have been consolidated into PE 0602384BP in accordance with P.L. 103-160.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 2 - Exploratory Development	PE NUMBER AND TITLE 0602789A Army Artificial Intelligence Technology PROJECT A880

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A880 Army Artificial Intelligence Technology	2655	2356	2166	2185	2207	2443	2498	2494	Continuing	Continuing

A. Mission Description and Budget Item Justification: The goal of the Artificial Intelligence (AI) exploratory development program is to mature AI technology for future insertion into Army applications to achieve the strategic advantage needed to perform the Army's world-wide mission. The threefold purpose of the program is to: (1) develop/apply AI technology to solve large scale, highly complex management problems; (2) investigate AI technology for use Army-wide (policy, personnel training and management, and applications development); and (3) transfer technology to the Army through exploratory development efforts. In addition, the program seeks to identify high potential, but embryonic AI methodologies and mature them for high payoff applications through targeted technology demonstration projects and the development of working models. This program has established a number of sophisticated AI cells (Knowledge Engineering Groups (KEGs)) focusing on the integration and application of AI technologies to problems in functional communities such as command and control, management, force integration, logistics, modeling, intelligence, resource management, test and evaluation, training, and medical. Focus for this science and technology effort is assisted through these functionally oriented cells. In addition, an Office of AI Research, Analysis and Evaluation has been established at the United States Military Academy to conduct AI applications research and development. The AI exploratory research program has established a solid foundation that will enable the Army to centrally manage and prevent duplication of effort in the Artificial Intelligence development arena. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This project includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2. This program is managed primarily by the US Army AI Center, Pentagon, with assistance from the US Army Training and Doctrine Command (TRADOC) AI Center, Ft. Monroe, VA; US Army Transportation Center, Ft. Eustis, VA; and the US Army Combined Arms Center, Ft. Leavenworth, KS.

Project A880 - Army Artificial Intelligence Technology

FY 1994 Accomplishments:
- Initiated command and control and decision support for senior Army leadership and war fighters (1702)
- Established diagnostics and prognostics using imagery to quickly identify problems in various areas of major systems (197)
- Tested and evaluated/verified and validated AI systems (286)
- Completed manufacturing and robotics AI systems in control of fiber optic winding process (320)
- Initiated intelligent computer aided training (ICAT) in support of intelligent simulation training for general purpose user signal equipment (150)

FY 1995 Planned Program:
- Apply AI technology to support the decision making process for command and control systems (1159)
- Integrate different technologies from multiple data bases by applying the use of AI technology to solve problems not easily solved by conventional programming (611)
- Effectively demonstrate how AI technology can significantly improve systems within manufacturing and robotic domains (284)

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- Demonstrate the integration of hybrid systems for the testing and evaluation of AI systems (253)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (49)

FY 1996 Planned Program:

- Demonstrate use of AI technology in integrating vastly different data and technologies to solve highly complex problems (557)
- Demonstrate effectiveness of hybrid systems within manufacturing and robotics domains (259)
- Investigate integration of hybrid systems within synthetic environments for command and control AI systems (1119)
- Demonstrate the integration of hybrid systems for the testing and evaluation of AI systems (231)

FY 1997 Planned Program:

- Demonstrate use of AI technology in integrating vastly different data and technologies to solve highly complex problems (562)
- Demonstrate effectiveness of hybrid systems within manufacturing and robotics domains (261)
- Investigate integration of hybrid systems within synthetic environments for command and control AI systems (1129)
- Demonstrate the integration of hybrid systems for the testing and evaluation of AI systems (233)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	2696	2388	2177	2196
Appropriated Value	2696	2356		
Adjustments to Appropriated Value	-41			
SBIR/STTR decrement (-41)				
Current President's Budget Submit	2655	2356	2166	2185

C. Other Program Funding Summary: NA

D. Schedule Profile: The efforts funded in this project are non-system specific and represent continuing exploratory development in the area of Artificial Intelligence, therefore no milestones or events are provided.

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	11186	14900	10569	13279	13854	14332	19349	21226	Continuing	Continuing
DC07 Joint Service Food Technology Demonstration	2380	1875	1946	2003	2061	2078	2195	2255	Continuing	Continuing
DC44 Tactical Logistics	414	389	796	697	0	0	0	0	0	2296
DJ28 Test Measurement Technology Development	934	341	0	259	414	597	800	998	Continuing	Continuing
DXXA Soldier Survivability	1398	4721	4962	5238	5137	4793	6862	7398	Continuing	Continuing
D242 Airdrop Equipment	1825	1588	1307	1285	1289	1308	1999	3392	Continuing	Continuing
D543 Ammunition Logistics	2627	4294	218	3339	4370	4859	6494	5986	Continuing	Continuing
D544 Cooperative Explosive Safety	941	818	995	0	0	0	0	0	0	2754
D594 Metrology and Calibration	667	874	345	458	583	697	999	1197	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program supports demonstration of technology for the dismounted soldier and materiel essential to support and sustain wartime operations and peacetime readiness, both strategically and tactically. Its purpose is to develop, demonstrate, and transfer affordable technologies to reduce the logistics burden on the battlefield, reduce operation and support (O&S) costs, and improve logistics system performance. This work is necessary because logistics support has been unable to keep pace with weapons systems technology. It includes diverse projects linked by broad applications benefiting whole categories of weapons systems and providing high return on investment. Enhancements to airdrop equipment for rapid deployment are required for dropping cargo from higher altitudes, greater offset distances and at higher speed, increasing survivability of aircraft and crews and increasing the probability that materials delivered will land in a usable condition. The Ammunition Logistics project supports weapon system rearm, ammunition management and accountability, and improvements in ammunition packaging, explosive safety, combat service support and sustainment. The Metrology and Calibration project is the only source which funds measurement science research and development within the Army and produces calibration equipment and capabilities essential for all major Army weapons systems and integrated digital battlefield communications. The Test Measurement Technology program develops diagnostics and prognostics technology to support a fix-forward capability. By embedding these technologies into weapons systems, maintenance time can be significantly reduced. The Joint Service Food Technology project demonstrates food service systems and food products, processing, preservation, and serving equipment resulting from technology programs approved by the Joint Services and the Defense Logistics Agency. The Tactical Logistics project demonstrates applications of technology for tactical electric power. Soldier Survivability, through the 21st Century Land Warrior Program, demonstrates the integration of advanced technologies to enhance soldier performance, lethality and survivability achieved by linking the modernized and technologically-

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advanced dismounted soldier directly to the battlefield via a digitized command and control network. The Cooperative Explosive Safety project is a three year effort resulting from a DoD/Nunn funded cooperative agreement between the United States and the Republic of Korea to mature new underground ammunition storage technologies, design concepts, and hazard area prediction models. Contractors performing the work for this PE include Martin-Marietta, Motorola, Rockwell International, Author D. Little, Tecogen, Pioneer Aerospace, Giordano Automation, and InterVision. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. This program adheres to Tri-Service Reliance Agreements on clothing, textiles and food, explosive ordnance disposal, and fuels and lubricants with oversight and coordination provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with efforts in PE #0602786A (Logistics Technology), Navy's integrated diagnostic support system, Missile Command Infrared (IR) scene generation, Advanced Research Project Agency (ARPA) millimeter/microwave integrated circuit (MMIC), Natick's Helmet Mounted Display, and the Joint Services Calibration Coordination Committee. The Ammunition Logistics project is related to PE #0602624A (Weapons And Munitions Technology) and PE #0603004A (Weapons and Munitions Advanced Development). These efforts contain no unwarranted duplication of effort among the Military Departments. This program is dedicated to conducting field demonstrations and tests of technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

Project DC07 - Joint Service Food Technology Demonstrations: Joint Service Food is a DoD program directed towards demonstrating nutritionally advanced rations and logistically streamlined food delivery systems to sustain DoD personnel in all operations and to enhance their combat performance under diverse battlefield scenarios. The project focuses on demonstrations of advances in food technology, materials, energy utilization, and combination heating technologies to provide extended, simplified field feeding without resupply. It exploits advances in ration formulation and quality, packaging, preservation, and nutritional content to improve morale, extend endurance, and sharpen mental acuity. This project is managed by the U.S. Army Natick Research, Development, and Engineering Center, Natick, MA.

FY 1994 Accomplishments:

- Completed field test on utility and acceptance of biodegradable spoons for Meals Ready to Eat (MRE); completed technical demonstration of biodegradable trash bags fabricated from starch based resins. Conducted shipboard and field evaluations to demonstrate acceptability of Biopol lined paper cups (363)
- Completed shipboard evaluations of food acceptability, labor requirements and worker opinions of substituting comparable convenience foods for labor intensive prepared from scratch products (460)
- Conducted producibility production test of mobility enhancing ration components (deli sandwiches) using Pilot Plant facilities; completed technical demonstration of Self Heating Group Ration during cold weather operations (515)
- Demonstrated, under field storage conditions, rapid assay methods for determining microbiological safety, color changes and sensory quality of rations; initiated reformulation of selected rations components based on degradation of quality during heat stress (382)
- Developed concept for a Rapid Deployment Kitchen based on thermal fluid heat transfer technology; established characteristics and initiated design of Rapid Deployment Kitchen (660)

FY 1995 Planned Program:

- Demonstrate producibility of biodegradable laminated cups, trays, and food packaging materials to enhance waste management and reduce disposal burden on ships and in the field (210)

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- Integrate advanced chemical heaters with rations to increase heat transfer efficiency and reduce hydrogen generation; conduct full scale tech demo of enhanced self-heating individual meals; continue technology insertion of promising food processing technologies (581)
- Conduct technical evaluation of prototype high heat stable rations which are formulated to improve acceptability and consumption rates; quantify ration acceptability and consumption/nutrient intake to ensure nutritional adequacy in thermally abusive environments (219)
- Transition to the Navy an automated food service system management tool that will allow modeling of the substitution of convenience foods for prepared from scratch products (314)
- Complete design and fabrication of Rapid Deployment Kitchen; prepare for technical demonstrations of thermal fluid heat transfer technology (511)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (40)

FY 1996 Planned Program:

- Demonstrate promising technologies (including aseptic/ohmic processing, and high barrier polymeric tray) for potential technology insertion, to expand combat ration variety and improve acceptability and nutrient retention (647)
- Demonstrate, under realistic field conditions, prototype high heat stable rations, evaluating the impact of nutrient content modifications and/or supplements to rations in hot weather feeding (330)
- Conduct initial technical demonstrations of Rapid Deployment Kitchen; identify deficiencies, correct problems, conduct final technical demonstrations, and transition to advanced development (569)
- Initiate development and demonstration of modular multipurpose thermal fluid heater for mobile military applications; investigate replacement of engine driven generators in field kitchens with solid state efficient heat driven generators (400)

FY 1997 Planned Program:

- Demonstrate self-heating, ready-to-eat characteristics of self-heating individual and group rations which exploit advances in ration packaging and food processing technologies (400)
- Demonstrate improved rations/consumption with a 15-20 percent increase in nutrient bioavailability (100)
- Transition technologies from exploratory development and conduct technical demonstrations of a 60K BTU/hour catalytic-vaporizing burner, and 8 cubic foot heat driven adsorption refrigerator, and a 1.5 GPM Nonpowered Instant Water Heater (393)
- Integrate modular multipurpose thermal fluid heater in the Rapid Deployment Kitchen and conduct technical demonstration (200)
- Demonstrate advanced packaging technologies based upon oxygen absorbing materials as an integral part of packaging system (365)
- Demonstrate lipid-based approaches to deliver performance enhancing nutrients and bioactive constituents to specific physiological sites (270)
- Demonstrate, under field conditions, a shelf-stable/fresh-like ration based on multiple barrier processing of marine products (275)

Project DC44 - Tactical Logistics: This project develops technology and materials to improve tactical electrical power availability for all DoD systems. Current efforts are directed to drastically lowering the size, weight, and number of engines, generators and auxiliary power units needed to power the battlefield. Programs specifically

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supported include Soldier Individual Power, the Joint Project Office for Unmanned Aerial Vehicles, and Special Operations Forces. This project is managed by the U.S. Army Communications-Electronics Command, Ft. Monmouth, NJ.

FY 1994 Accomplishments:
- Continued component integration for integrated and modular power system rated at 400 watts for microclimate cooling for the soldier system (414)

FY 1995 Planned Program:
- Complete effort by demonstrating a 3 lb., 400 watt engine-generator module for the Soldier Individual Power program (381)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (8)

FY 1996 Planned Program:
- Complete fuel cell power development for the 21st Century Land Warrior (21CLW) (700)
- Complete lightweight engine, generator and electronics integration by demonstrating an 18-pound, 1500-watt generator that runs on JP-8 fuel (96)

FY 1997 Planned Program:
- Continue integration designs to reduce the size and weight of the fuel cell (697)

Project DJ28 - Test Measurement Technology Development: This program develops diagnostics and prognostics technology to allow weapon systems to anticipate failure or, when failure occurs, self diagnose by means of embedded diagnostics. Embedded diagnostics makes possible multicapable maintainers, allowing a reduction in the number of Military Occupational Specialties (MOS) and training times; it also supports the concept of "fix forward" for the purpose of reducing the levels of maintenance. As part of the Louisiana Maneuvers, older systems will be maintained by a wearable, hands-free, intelligent maintenance aid now under development. This technology is currently being applied to the Advanced Field Artillery System (AFAS)/Future Armored Resupply Vehicle (FARV), PALADIN, Rapid Prototyping of Application Specific Signal Processors (RASSP), and the Advanced Threat Radar Jammer systems. This project is managed by the U.S. Army Test, Measurement, and Diagnostic Equipment Activity, Redstone Arsenal, AL.

FY 1994 Accomplishments:
- Demonstrated Diagnostic Analysis and Reasoning Tool Set (DARTS) on a microprocessor for built-in diagnostics (BID) (350)
- Demonstrated a wearable intelligent maintenance aid to provide rapid forward area diagnostic at the weapon system (284)
- Fabricated and demonstrated the millimeter/microwave integrated circuit (MMIC) technology built-in test (BIT) chip in the Advanced Radar Jammer (300)

FY 1995 Planned Program:
- Develop Test Program Set (TPS) Reuse Library as a means of controlling escalating costs associated with TPS developments (200)
- Conduct research/modeling to optimize the calibration interval of Army test equipment (134)

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- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (7)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program:
- Develop plan for remote analysis of embedded diagnostics of AFAS for one-hour meantime to repair (50)
- Complete and demonstrate development of TPS Reuse Library (150)
- Demonstrate open-architecture, diagnostics-driven, electronic maintenance system for elimination of current paper/electronic manuals (59)

Project DXXA - Soldier Survivability: This project addresses the critical Army need to enhance the performance, lethality, survivability, and sustainment of the individual soldier. It includes the Generation II (GEN II) Soldier System technology demonstration, which is part of the 21st Century Land Warrior Program. The GEN II Soldier System will integrate several elements including advanced electronics, communications, sensors, individual equipment, weaponry, and hazard protection items, into a functioning, balanced, unified system demonstration. The GEN II Soldier System will demonstrate the enhanced soldier lethality and survivability achieved by linking the modernized and technologically advanced dismounted soldier directly to the battlefield via a digitized command and control network coupled with other specific enhancements (e.g. new weapon/fire control, small arms protection). This will be accomplished by the use of modular subsystems that will provide flexibility and variety in use, and will allow mission tailoring without the burden of wearing/carrying items unnecessary for the mission. The system will provide the flexibility to optimize the balance between soldier/equipment performance and individual protection in responding to varying threats and operational requirements. GEN II will leverage the commercial microelectronics and telecommunications industries to achieve lightweight, miniaturized components. The U.S. Marine Corps and the Special Operations Forces are active participants in this program. This program is managed by the U.S. Army Natick Research, Development, and Engineering Center, Natick, MA.

FY 1994 Accomplishments:
- Investigated viable state-of-the-art technologies, design concepts, and advanced material systems, to support the full exploitation of all available and emerging technologies for GEN II; initiated trade studies to identify critical component/systems drivers and technical risks; and coordinated the cognitive informational and performance requirements with the GEN II user (1398)

FY 1995 Planned Program:
- Develop conceptual designs for the system; evaluate preliminary design concepts; select the most feasible approach(es); initiate breadboard level designs and fabrication of the critical components/system drivers for FY 1996 validation (4622)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (99)

FY 1996 Planned Program:

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- Complete fabrication of critical breadboard components/system drivers; conduct Battle Lab Warfighting Experiment (BLWE) to assess and validate critical breadboard hardware and command and control protocols; initiate detailed design of entire system (4962)

FY 1997 Planned Program:

- Complete system design and conduct BLWE with two complete systems, both in the field and through modeling and simulation, to validate system design, integration compatibility and operational suitability; finalize system design and begin manufacturing up to 36 GEN II Soldier Systems (5238)

Project D242 - Airdrop Equipment: This project focuses on the demonstration and development of innovative techniques and equipment for aerial delivery of cargo. The goal is precision delivery of heavier payloads from extremely high altitude (up to 25,000 ft) and offset distance. Delivery from high altitudes and offset distance improves cargo/personnel and aircraft survivability. A major effort in FY 1996 is the Advanced Airdrop for the Land Combat advanced technology demonstration which includes offset delivery through the deployment of very large ram-air canopies with automated guidance and control of non-powered gliding decelerators and an automated soft landing capability. The conflict in Bosnia focused attention on the need for air delivery systems that reduce the vulnerability of personnel and aircraft. This high priority effort will demonstrate precision delivery of 42,000 lb. of cargo (e.g., supplies and equipment) from altitudes of up to 25,000 ft. This project is managed by U.S. Army Natick Research, Development, and Engineering Center, Natick, MA.

FY 1994 Accomplishments:

- Integrated autonomous global positioning system (GPS) guidance, navigation and control (GN&C) into existing 15,000 lb. prototype parafoil system and conducted airdrop tests (604)
- Designed, fabricated prototypes and conducted instrumented airdrop tests of the 42,000 lb. capacity parafoil (1112)
- Initiated integration of autonomous GPS GN&C into 42,000 lb. capacity prototype parafoil system (109)

FY 1995 Planned Program:

- Conclude instrumented airdrop tests of 42,000 lb. capacity parafoil (74)
- Conduct testing of 42,000 lb. capacity prototype parafoil system integrated with autonomous GPS GN&C to demonstrate precision delivery of load within a 100 meter radius circle of the target (430)
- Design and integrate soft landing capability into 42,000 lb. capacity autonomous prototype parafoil and conduct instrumented airdrop tests (1050)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (34)

FY 1996 Planned Program:

- Continue testing of 42,000 lb. capacity prototype parafoil system with autonomous GPS GN&C and soft landing capability (600)
- Conduct Advanced Technology Demonstration (ATD) of complete 42,000 lb. capacity parafoil system (200)
- Define concepts for High Glide Air Delivery (HGAD) system to provide a three-fold increase in offset distance over ATD parafoil system to safely deliver vehicles, munitions and equipment (507)

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FY 1997 Planned Program:
- Fabricate High Glide Air Delivery system prototype using high glide wing technology (744)
- Conduct technical evaluation of High Glide Air Delivery system (250)
- Demonstrate interim 20,000 lb. high glide air delivery system (291)

Project D543 - Ammunition Logistics: This project satisfies a critical need for improved systems to project, sustain and support operations and peacetime readiness for both strategic and tactical scenarios. It will improve ammunition and missile packaging/palletization and weapon system rearm for artillery, armor, air defense, aviation, and infantry, as well as enhance explosive safety, combat service support and command, control, communication, and computers (C4) for ammunition management. It also exploits emerging technologies and productivity enhancers/cost savers aimed at quantum improvements to the force projection logistics system (strategic) and the combat focused logistics system (tactical). This project is managed by the U.S. Army Armaments Research, Development, and Engineering Center, Picatinny Arsenal, NJ. Efforts will transition to weapons and munitions technology/development programs, the Total Distribution System, Rapid Force Projection Initiative (lightweight automated howitzer), PM Patriot, and others.

FY 1994 Accomplishments:
- Integrated Forward Arming and Refueling Point Operational Model upgrade with Louisiana Maneuvers model; demonstrated Modular Aviation Rearm Resupply System (MARRS) components/procedures; fabricated prototype extraction system for MARRS rocket/missile weapon system rearm (415)
- Completed mechanical/controls design of an advanced technology computer controlled arm/"smart" crane to improve rearm of Theater High Altitude Air Defense (THAAD) missiles (689)
- Completed Standard Army Ammunition System (SAAS) - Ammunition Transfer Point (SAAS-ATP) final report and transitioned technology to PM SAAS (58)
- Completed Insensitive Munitions Packaging Technology (IMPACT) prototype system designs for candidate munitions (904)
- Developed crew saving resupply/rearm concepts for the Lightweight 155mm howitzer (74)
- Completed Artillery Rearm Module (ARM) II safety certification testing, conducted user demonstration, and transitioned to PM FARV (448)
- Safety certified Loose Mine Restraint System (LMRS) and transitioned technical data package to the US Army Engineer School (5)
- Developed test plan for evaluation of the latest generation of radio frequency (RF) based data transceiving devices for application to ammunition asset management systems (34)

FY 1995 Planned Program:
- Select concepts and design of resupply/rearm systems for lightweight towed 155mm howitzer (324)
- Install the ARM on a Heavy Expanded Mobility Tactical Truck (HEMTT) and conduct Fastload demonstration of self-propelled howitzer rearm/resupply (668)
- Complete engineering test and evaluation of MARRS missile/rocket rearm system for attack helicopters (142)
- Select concepts and design munitions packaging improvements; establish common tri-service Ammunition Packaging Information Center on the Internet (885)
- Fabricate prototype insensitive munitions (IM) containers and conduct IM and hazard classification testing of ammunition packaging safety improvements (997)

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- Complete design of an advanced, machine vision fire detection and suppression system for ammunition load plants (210)
- Complete test, evaluation, and report on feasibility of 5.56mm rapid magazine loading systems for firearms (1000)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (68)

FY 1996 Planned Program:
- Complete demonstration of prototype IM packaging and finalize technical data package (218)

FY 1997 Planned Program:
- Fabricate the lightweight towed 155mm howitzer rearm/resupply system (972)
- Fabricate and test improved munitions packaging prototypes; complete integration of tri-service Ammunition Packaging Information Center on the Internet (1000)
- Install, test and demonstrate an advanced, machine vision fire detection and suppression system for ammo load plants (250)
- Develop teleoperation hardware and control system software for the Smart Crane Ammunition Transfer System (767)
- Design and conduct logistics assessments of an ammunition barricading system to provide optimum survivability of critical munition supplies during wartime operations (350)

Project D544 - Cooperative Explosive Safety: This is a cooperative program with the Republic of Korea (ROK). Efforts are devoted to improving ammunition explosives safety through technology solutions. The effort focuses on the development, testing, and validation of new underground explosives storage techniques which will reduce explosives storage hazards with no reduction in security, operational readiness, or logistical support. Results of the effort are anticipated to produce approved underground storage designs and revised US explosives safety criteria and have the impact of increasing ammunition storage safety throughout the Department of Defense (DoD) ammunition storage complex. This project is managed by the U.S. Army Technical Center for Explosives Safety, Savanna, IL.

FY 1994 Accomplishments:
- Conducted and completed intermediate-scale testing of the most promising underground storage design concepts (636)
- Completed correlation and analysis of all experimental test data (250)
- Developed initial plan for validation test (55)

FY 1995 Planned Program:
- Develop computer-based design and hazard prediction for underground magazines (225)
- Complete the final design and construction of large-scale prototype underground magazine for validation testing (576)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (17)

FY 1996 Planned Program:
- Conduct validation test and evaluate test data (150)

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- Integrate test data and logistics considerations into operational full-scale underground facility concept (325)
- Develop and complete technical designs and data packages of full-scale facilities for underground ammunition storage (520)

FY 1997 Planned Program: Project not funded

Project D594 - Metrology and Calibration: This project provides Army weapon systems and technology developers with legally mandated, traceable calibration equipment for microwave, electro-optics, mechanical, and electronic systems. New, high-technology weapons systems cannot be developed, tested, or maintained without matching calibration systems. This is a Joint Logistics Commanders program, closely coordinated with the Navy and Air Force, which directly supports Army research, development, and engineering centers (RDECs), test ranges, and proving grounds. Among the weapons systems directly supported are Search and Destroy Armor (SADARM), Longbow, Military Strategy Tactical and Relay Satellite System (MILSTAR), Integrated Family of Test Equipment (IFTE), and High Power Coherent Radar (HIPCOR). The Intrinsic Standards Voltage Calibrator that stems from this project is an advance of international significance, and was reported at the National Conference of Standards Laboratory Conference in 1994. The United States National Institute for Standards and Technology (NIST) directly participated in this calibrator program and benefited from technology transfer, as has the United States cryogenics industry. The calibrator has improved the Army's calibration program, and the U.S. Navy, Air Force, and NASA are expected to apply this technology to their programs. This project is managed by the U.S. Army Test Measurement and Diagnostic Equipment Activity, Redstone Arsenal, AL.

FY 1994 Accomplishments:
- Initiated development of a downsized, portable, refrigerator-cooled Josephson Junction primary voltage standard (340)
- Developed a downsized VXI-based microwave calibration workstation (200)
- Demonstrated a frequency linked (via Global Positioning Satellite) intrinsic voltage standard (127)

FY 1995 Planned Program:
- Incorporate the utilization of the Josephson Junction intrinsic voltage standard into the next generation Calibration Van (CALSETS 2000) (150)
- Test and evaluate the reconfigurable microwave calibration workstation for technology transfer (150)
- Investigate the parameters required to achieve self-calibration of the CALSETS 2000 design to eliminate the calibration logistical tail (200)
- Develop technology for primary level calibrations for Fourier Transform Infrared (FTIR) non-linearity effects, AM noise and 6-port microwave calibrations (356)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (18)

FY 1996 Planned Program:
- Complete Automated Network Analyzer Verification Program for Army microwave calibration (145)
- Place on line AM phase noise measurement services to Army RDECs through the Army Primary Standards Laboratory (50)
- Test CALSETS 2000 Data Assessor System (150)

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FY 1997 Planned Program:

- Develop Josephson Junction intrinsic voltage standard for instrument rack operation (200)
- Develop low-voltage calibration workstation for next generation calibration van (CALSETS 2000) (200)
- Demonstrate self-calibration scheme for CALSETS 2000 (58)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	12897	14386	14957	14628
Appropriated Value	12897	14900		
Adjustments to Appropriated Value	-1711			
a. SBIR/STTR decrement (-196)				
b. Reprogramming Total (-1515)				
Current President's Budget Submit	11186	14900	10569	13279

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PROJECT: DC07

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DC07 Joint Service Food Technology Demonstration	2380	1875	1946	2003	2061	2078	2195	2255	Continuing	Continuing

C. **Other Program Funding Summary**: See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct tech demo of biodegradable utensils and trash bags				X*												
Complete demo and data collection on labor saving convenience food concepts				X*												
Field demo of prototype high-heat stable rations												X				

* Denotes Completed Effort

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: DC44

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DC44 Tactical Logistics	414	389	796	697	0	0	0	0	0	2296

C. Other Program Funding Summary. See Paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demo a 3-lb., 400-watt engine-generator module for Soldier Power Program								X								
Demo a 15-lb. microclimate cooling system for 21CLW												X				
Demo an 18-lb., 1500 watt generator that runs on JP-8 fuel												X				

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: DJ28

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DJ28 Test Measurement Technology Development	934	341	0	259	414	597	800	998	Continuing	Continuing

C. **Other Program Funding Summary.** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demonstrate DARTS toolset on a micro-processor for built-in diagnostics								X								
Develop a wearable, light-weight candidate maintenance aid for future CTS-III replacement								X								

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PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: DXXA

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DXXA Soldier Survivability	1398	4721	4962	5238	5137	4793	6862	7398	Continuing	Continuing

C. **Other Program Funding Summary**. See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct Battle Lab Warfighting Experiment (BLWE) with two 21 CLW systems																X

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PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: D242

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D242 Airdrop Equipment	1825	1588	1307	1285	1289	1308	1999	3392	Continuing	Continuing

C. Other Program Funding Summary. See Paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct Advanced Technology Demonstration (ATD) of complete 42,000 lb. capacity parafoil system									X							
Demonstrate interim 20,000 lb. High *Glide Air Delivery System*																X

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: D543

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D543 Ammunition Logistics	2627	4294	218	3339	4370	4859	6494	5986	Continuing	Continuing

C. **Other Program Funding Summary.** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete testing and transition IM packaging technology to item developers												X				
Fabricate the Lightweight 155mm Howitzer rearm/resupply system																X
Fabricate and test improved munitions packaging prototypes																X
Complete integration of tri-service Ammunition Packaging Information Center															X	
Demonstrate an advanced, machine vision fire detection and suppression system																X
Develop teleoperation hardware and control system software for the Smart Crane Ammunition Transfer System																X

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: D544

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D544 Cooperative Explosive Safety	941	818	995	0	0	0	0	0	0	2754

C. **Other Program Funding Summary.** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct and complete intermediate-scale testing of the most promising underground storage design concepts				X*												
Complete correlation and analysis of all experimental test data				X*												
Conduct validation test and evaluate test data									X							
Integrate test data and logistics considerations into operational full-scale underground facility concept											X					
Develop and complete technical designs and data packages of full-scale facilities for underground ammunition storage												X				

* Denotes Completed Effort

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603001A Logistics Advanced Technology

PROJECT: D594

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D594 Metrology and Calibration	667	874	345	458	583	697	999	1197	Continuing	Continuing

C. **Other Program Funding Summary.** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete development of a down-sized, refrigerator-cooled, portable Josephson Junction primary voltage standard								X								
Develop a downsized VXI-based microwave calibration				X*												

* Denotes Completed Effort

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

COST (*In Thousands*)		FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	111666	252543	11760	12099	12422	11540	12236	12500	Continuing	Continuing
D799	Depleted Uranium Effects	419	0	0	0	0	0	0	0	0	419
D800	Telemedicine Testbed	984	0	0	0	0	0	0	0	0	984
D801	Defense Woman's Health Research	39380	39460	0	0	0	0	0	0	0	78840
D803	Louisiana Touro Infirmary	1161	0	0	0	0	0	0	0	0	1161
D804	Prostate Cancer Research	1969	4192	0	0	0	0	0	0	0	6161
D806	Breast Cancer Research	29535	147976	0	0	0	0	0	0	0	177511
D807	Industrial Base/Medical Biological Defense Vaccines and Drugs *	14586	15670	0	0	0	0	0	0	0	30256
D810	Industrial Base/Infectious Disease Vaccines and Drugs	6233	8494	9373	9655	9944	9001	9136	9322	Continuing	Continuing
D819	Field Medical Protection and Human Performance Enhancement-Non-Systems Advanced Development	739	740	0	0	0	0	525	550	Continuing	Continuing
D840	Combat Injury Management	2752	2321	2387	2444	2478	2539	2575	2628	Continuing	Continuing
D886	Mammography	0	1974	0	0	0	0	0	0	0	1974
D887	Ovarian Cancer Research	0	7399	0	0	0	0	0	0	0	7399
D888	Cell Regulation Research	0	1974	0	0	0	0	0	0	0	1974
D889	Coastal Cancer Control	0	4933	0	0	0	0	0	0	0	4933

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PE NUMBER AND TITLE: 0603002A Medical Advanced Technology

COST (*in Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D890 Osteoporosis	0	4933	0	0	0	0	0	0	0	4933
D891 Lyme Disease	0	493	0	0	0	0	0	0	0	493
D995 Medical Chemical Defense Life Support Material-Non-Systems Advanced Development *	11888	11984	0	0	0	0	0	0	0	23872

* Starting in FY 1996, funding has been consolidated into PE 0603384BP in accordance with P.L. 103-160.

A. Mission Description and Budget Item Justification: This program element funds advanced technology development for the DoD Core Vaccine and Drug Program as well as for development of field medical protective devices and combat injury management. These latter two projects focus on diagnostic imaging devices, clinical studies of combat casualty care treatment modalities, and nutrition and soldier performance enhancement. The DoD Core Vaccine and Drug Program provides, in accordance with Food and Drug Administration (FDA) regulations, drugs and vaccines for development which are effective protectants, treatments, and antidotes against chemical and biological threat agents, and military disease threats. Starting in FY 1996, funding for chemical and biological defense medical research and development efforts (projects D807 and D995) have been consolidated into PE 0603384BP in accordance with P.L. 103-160. Pilot and standard lots of candidate pharmaceutical-grade drugs, antidotes and vaccines are produced. Medical biological and chemical defense development consists of prophylaxes, pretreatment, antidotes and therapeutics; personnel and patient decontamination; medical management of casualties and sustainment of combat effectiveness. 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 short of war. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This program is managed primarily by the US Army Medical Research and Materiel Command. This program is dedicated to conducting proof of principal field demonstrations and tests of non-system-specific technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

Project D799-Depleted Uranium Effects: By Congressional direction, the purpose of this project is to study the possible short and long-term effects on the health of personnel who were exposed to depleted uranium on the battlefield.

FY 1994 Accomplishments:

- Determined the inflammatory response and neurotoxicological consequences of embedded depleted uranium fragments. (200)
- Determined the carcinogenic potential of embedded depleted uranium fragments. (219)

FY 1995 Planned Program: Project not funded

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FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D800-Telemedicine Testbed: The purpose of this project is to conduct research on imaging, diagnosis, and electronic connectivity of military and federal facilities to demonstrate emerging telemedicine capabilities. Congress added funding for this project in FY94.

FY 1994 Accomplishments:
- Supported a telemedicine testbed for medical digital imaging support of a computerized network for transmittal of digital radiographic images. (984)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D801 Defense Woman's Health Research: By Congressional direction, the purpose of this project is to develop a coordinated tri-service program of multi-disciplinary and multi-institution research on women's health issues related to service in the Armed Forces.

FY 1994 Accomplishments:
- Described the health problems, including injury and illness rates, for women aboard ships, Air Force military recruits, and deployed Army women. (4000)
- Investigated the problems and effects of sexual harassment and gender bias on integration of women into military units. (3500)
- Determined problems and solutions to overcome physiological limitations of military women, including inadequate iron intake, postpartum return to duty standards, and upper body muscular strength. (3500)
- Improved medical diagnostic methods and criteria for illnesses affecting military women, including endometrial hyperplasia, mycoplasma infections, nongonoccal urethritis, and pelvic inflammatory disease. (2000)
- Investigated potential physiological differences in female responses to environmental hazards including high G-forces and heat stress. (3000)
- Established a Defense Women's Health Research Program clearing house/database. (4000)
- Awarded extramural contracts for related research. (19380)

FY 1995 Planned Program:
- Continue the FY94 program with a new call for intra- and extramural proposals. (38632)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (828)

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FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D803-Louisiana Touro Infirmary: By Congressional direction, the purpose of this project is to evaluate an antibacterial treatment for Gulf War Illness.

FY 1994 Accomplishments:
- Awarded contract/grant to evaluate an antibacterial treatment for the Gulf War Illness. (1181)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D804-Prostate Cancer Research: By Congressional direction, the purpose of this project is to establish a prostate cancer research center at the Walter Reed Army Institute of Research.

FY 1994 Accomplishments:
- Established a prostate cancer research center. (1969)

FY 1995 Planned Program:
- Support prostrate cancer research center. (4104)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (88)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D806-Breast Cancer Research: By Congressional direction, the purpose of this project is to initiate breast cancer research within the Department of Defense.

FY 1994 Accomplishments:
- Transferred funds to National Naval Medical Center for Breast Cancer Research. (4922)

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- Awarded contracts/grants for breast cancer research in accordance with the Institute of Medicine's recommended funding strategy. (24613)

FY 1995 Planned Program:
- Support a breast cancer research program in the Department of Defense. (144868)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (3108)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D807-Industrial Base/Medical Biological Defense Vaccines and Drugs: This project funds research on pre-clinical development of safe and effective prophylaxis and therapy (vaccines and drugs for exposure to biological threat agents). This project also supports the advanced technology development of kits to rapidly diagnose exposure to biological agents in clinical samples. To complete the defensive effort, a broad range of technologies involved in the targeting and delivery of prophylactic and therapeutic medical countermeasures is evaluated to ensure the protection of US forces. Major contractors are Battelle Memorial Institute, Columbus, OH, and Southern Research Institute, Birmingham, AL.

FY 1994 Accomplishments:
- Evaluated the efficacy of the Cutter Plague vaccine, and demonstrated protective immunity by candidate vaccines directed against other bacterial threat agents. (2794)
- Conducted advanced screening for safety, efficacy, and toxicity of candidate Venezuelan equine encephalitis vaccines. (592)
- Transitioned ricin toxoid to advanced development, and assessed candidate solutions for other biological toxins. (7277)
- Conducted demonstrations of a candidate technology for field diagnosis of biological threat agents. (3225)
- Conducted advanced pre-clinical prophylaxis studies on medical countermeasures to biological threat agents. (698)

FY 1995 Planned Program:
- Demonstrate the efficacy of candidate Anthrax vaccines in non-human primates, and utilize defined animal models to evaluate the efficacy of other bacterial vaccine candidates. (2901)
- Screen candidate Venezuelan equine encephalitis vaccines for safety, efficacy and toxicity. (754)
- Transition Staphylococcal Enterotoxin B toxoid to advanced development, and assess candidate solutions for other identified biological toxins. (7713)
- Assess and validate models, assays, and manufacturing technologies to support product development of diagnostic confirmation assays of biological threat agents. (3815)
- Conduct advanced pre-clinical prophylaxis studies on medical countermeasures to biological threat agents. (158)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (329)

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FY 1996 Planned Program: Project moved to DoD PE 0603384BP, project number D07

FY 1997 Planned Program: Project moved to DoD PE 0603384BP, project number D07.

Project D810-Industrial Base/Infectious Disease and Drugs: This project funds development of medical countermeasures for naturally occurring diseases which are militarily significant due to their potential impact on military operations. Development of medical countermeasures will protect the force from infection and sustain operations by preventing hospitalization and evacuations from the theater of operations. Major contractors are the University of Georgia, Athens, GA, University of Miami School of Medicine, Miami, FL, Kenya Medical Research Institute, Nairobi, Kenya, University of North Carolina, Chapel Hill, NC, and Korea University, Seoul Korea.

FY 1994 Accomplishments:

- Conducted Phase I clinical trial of candidate vaccines for shigella dysentery, campylobacter diarrhea, and enterotoxigenic E. coli (ETEC) diarrheal disease (traveler's diarrhea), and live attenuated hepatitis-A; established field sites for trials against endemic disease. (1721)
- Conducted pre-clinical safety tests and Phase I clinical trials of azithromycin against multidrug resistant strains of malaria and leishmaniasis; established field sites for trials against endemic disease. (3801)
- Developed an animal model for evaluation of safety and efficacy of meningitis vaccines for transition to clinical trials; prepared technical data package to transition scrub typhus diagnostic assay to advanced development. (324)
- Conducted Phase I clinical trial on recombinant, vectored circumsporozoite malaria vaccine in human volunteers; established field site for large scale clinical trials of malaria vaccines in endemic regions. (1763)
- Evaluated means to enhance immune response to candidate dengue fever vaccines; established field site for large scale clinical trials in endemic regions. (624)

FY 1995 Planned Program:

- Evaluate immunogenicity of single and multiple component campylobacter vaccine candidates; conduct Phase I clinical trial of live attenuated Shigella and traveler's diarrhea vaccines; complete trials of live attenuated hepatitis A vaccine. (2571)
- Prepare pre-clinical and technical data package to transition an antimalarial drug to advanced development; complete pre-clinical drug formulation and pharmacokinetic studies of candidate antimalarial and antileishmanial drugs. (3184)
- Complete clinical safety and immunogenicity studies of liposomal encapsulated malaria vaccine in human volunteers; select malaria vaccine and vaccine formulation for transition to advanced development; transition leishmaniasis skin test advanced development. (1898)
- Conduct Phase I clinical trial of candidate group B meningitis vaccine in volunteers. (454)
- Complete preparation of field sites for large scale clinical trials on vaccines in volunteers naturally infected with endemic diseases. (209)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (178)

FY 1996 Planned Program:

- Conduct Phase I clinical safety and efficacy trials of candidate vaccines to prevent ETEC and campylobacter diarrheal disease. (1369)

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- Conduct Phase I clinical trial of Plasmodium vivax blood stage vaccine to prevent relapsing malaria. (1680)
- Conduct pre-clinical and clinical safety and efficacy studies of an endotoxin neutralizing antibody to protect soldiers from septic shock; complete clinical trials to advance a polyvalent meningitis vaccine to advanced development. (344)
- Conduct Phase I clinical trials of candidate dengue fever vaccines, and hanta virus vaccine. (2773)
- Conduct pre-clinical safety and efficacy trials of candidate antimalarial and antileishmanial drugs, and complete clinical trial of azithromycin as chemoprophylaxis agent against drug resistant malaria. (3207)

FY 1997 Planned Program:

- Complete clinical Phase I safety and efficacy trials of live attenuated Shigella sonnei vaccine required for transition to advanced development. (1545)
- Conduct Phase I clinical safety and efficacy trials on a liposomal formulation of pentamidine as an antileishmanial drug; conduct Phase I clinical trials of an artemisin analog as a potential treatment for cerebral malaria. (3252)
- Conduct safety and efficacy trials on an enhanced formulation of a blood stage P. vivax vaccine to prevent relapsing malaria. (1854)
- Conduct Phase I clinical trial of a subunit vaccine against gonorrhea; conduct Phase I clinical safety and efficacy trial of a combined wound sepsis vaccine and Klebsiella, Pseudomonas, E. coli, and Staphylococcus species. (348)
- Conduct clinical trial of N, N-diethyl-m-toluamide (DEET) replacement insect repellent formulation; conduct Phase I clinical trials of vaccines against dengue fever. (2656)

Project D819-Field Medical Protection and Human Performance Enhancement-Non-Systems Advanced Development: This project supports laboratory validation studies and field demonstrations focused on soldier protection, sustainment, and enhancement associated with soldiers operating, wearing and consuming materiel systems in all climatic and operational conditions. Specific support includes medical non-systems advanced development of laser eye protection technologies and laser bioeffects treatment, medical protection against military electromagnetic radiation hazards, environmental health monitoring methods to link soldier physiological status with climatic and environmental conditions, methods to enhance sleep and alertness during continuous/sustained operational scenarios, nutritional strategies to enhance soldier mental and physiological performance, and medical protection from vibration and repeated shock hazards arising from the operation of combat vehicle and aircraft systems. Research efforts are categorized by five major thrust areas: Operational Medicine and Performance; Environmental Extremes; Directed Energy Bioeffects; Toxic Hazards Health effects; and Biodynamic Stresses.

FY 1994 Accomplishments:

- Investigated the usefulness of dietary manipulation as a means of preventing behavioral, endocrine, and immunological dysfunction induced by sleep and/or caloric deprivation and its associated stress in elite soldiers and women in basic training. (739)

FY 1995 Planned Program:

- Study physical and mental performance requirements of combat soldiers and extend performance limits. Evaluate performance effects of various nutrient supplements. (724)

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- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (16)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project A840-Combat Injury Management: This project funds advanced development prototypes of non-system specific medical material items for far-forward medical management of shock and trauma, and for casualty resuscitation, including pre-clinical testing of large standard lots of candidate compounds and equipment, to obtain data necessary for Food and Drug Administration (FDA) approval for human use. A major contractor is Tufts University, Boston, MA.

FY 1994 Accomplishments:
- Expanded investigation of the hypertensive effect of model hemoglobin compounds in rabbit and swine models; tested tissue adhesive for affecting wound stabilization, hemorrhage control, and healing. (1148)
- Formulated large biodegradable macro beads for use in infection control of large traumatic injuries. (684)
- Completed technical demonstration of medic bag and supply packet for casualty aid. (492)
- Completed evaluations and testing for Field Triage Light and Field Anesthesia Machine. (428)

FY 1995 Planned Program:
- Provide assessments of the safety of acellular hemoglobin for use as a blood substitute; provide doctrine to effectively incorporate Hypertonic Saline Dextran into military medicine. (591)
- Identify mechanisms controlling new blood vessel growth during wound healing. (531)
- Refine high frequency mechanical ventilator; expand investigation/evaluation of innovative/novel technologies to determine their role in improving field medical care. (1151)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (48)

FY 1996 Planned Program:
- Determine efficacy of biodegradable macro beads, coated with antibiotic, in the treatment of infection in small mammals. (700)
- Defeat hypertensive mechanism of stroma-free hemoglobin resuscitation solutions. (887)
- Determine limits of ability to stimulate new blood vessel growth in skeletal muscle following crush injury muscle trauma (500)
- Complete transition of high frequency ventilator to advanced development. (300)

FY 1997 Planned Program:
- Determine effect of resuscitation fluid temperature using novel microwave warming device for I.V. fluids. (500)

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- Identify roles for microwave radiometer as a non-invasive physiologic sensor in the treatment of combat trauma. (444)
- Compare resuscitation effects of stroma-free hemoglobin solutions with lipid encapsulated hemoglobin and Hypertonic Saline Dextran. (800)
- Refine adhesive properties of selected tissue adhesives of local hemostatic agents proposed for use in uncontrolled truncal or extremity hemorrhage. (700)

Project D886-Mammography: By Congressional direction, this project will support research on mammography.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Award competitive contracts/grants to initiate research on mammography. (1933)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (41)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D887-Ovarian Cancer Research: By Congressional direction, this project will support research on ovarian cancer.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Award competitive contracts/grants to initiate research on ovarian cancer. (7244)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (155)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D888-Cell Regulation Research: By Congressional direction, this project will support research on cell regulation.

FY 1994 Accomplishments: Project not funded

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FY 1995 Planned Program:
- Award competitive contracts/grants to initiate research on cell regulation. (1933)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (41)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D889-Coastal Cancer Control: By Congressional direction, this project will support research on coastal cancer control.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Award competitive contracts/grants to initiate research on coastal cancer control. (4829)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (104)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D890-Osteoporosis: By Congressional direction, this project will support research on osteoporosis.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Award competitive contracts/grants to initiate research on osteoporosis. (4829)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (104)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D891-Lyme Disease: By Congressional direction, this project will support research on Lyme Disease.

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FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Award competitive contracts/grants to initiate research on Lyme Disease. (483)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (10)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D995-Medical Chemical Defense Life Support Materiel-Non-Systems Specific Advanced Development: This project supports the investigation of new medical countermeasures to include antidotes, pretreatment drugs, and topical skin protectants to protect U. S. forces against known and emerging chemical warfare (CW) threat agents. Capabilities are maintained for reformulation, formulation, and scale-up of candidate compounds using current good laboratory practices (CGLP). Analytical stability studies and safety and efficacy screening, in addition to pre-clinical toxicology studies, are performed prior to full scale development on promising pretreatment or treatment compounds. Some major contractors are Battelle Memorial Institute, Columbus, OH, Rolm and Haas Company, Spring House, PA, Science Application International Corporation, McLean, VA, Research Triangle Institute, Research Triangle, NC, and Ash Stevens, Inc., Detroit, MI.

FY 1994 Accomplishments:
- Developed medical countermeasures to sulfur mustard; produced reactive components for topical skin protectant; validated tests for vesicants in biological fluids. (7650)
- Prepared to transition to advanced development a methemoglobin-forming pharmaceutical for protection against cyanide. (2210)
- Explored potential antibodies to specific biochemical stages of the nerve agent poisoning process; validated methods to detect agents in biological fluids. (1226)
- Investigated advanced biotechnological approaches to development of catalytic and immunological scavengers for nerve agents. (802)

FY 1995 Planned Program:
- Identify most promising medical countermeasures to sulfur mustard; produce reactive components for topical skin protectant; validate tests for vesicants in biological fluids. (7543)
- Transition to advanced development a methemoglobin-forming pharmaceutical for protection against cyanide (2267)
- Investigate most promising antibodies to specific biochemical stages of the nerve agent poisoning process; validate methods to detect agents in biological fluids. (564)
- Develop decontamination, diagnostic, prognostic, and treatment procedures directly applicable to patient management. (1358)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (252)

- **FY 1996 Planned Program:** Project moved to DoD PE 0603384BP, project number D95.

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603002A Medical Advanced Technology

- **FY 1997 Planned Program:** Project moved to DoD PE 0603384BP, project number D95.

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	115000	41028	34773	35225
Appropriated Value	115000	252543		
Adjustments to Appropriated Value	-3263			
a. SBIR/STTR (-1782)				
b. Reprogramming (-1481)				
Current President's Budget Submit	111666	252543	11760	12099

Changes to FY 1997/FY 1997: Funding for chemical and biological defense efforts (projects D807 and D995) have been consolidated in PE 0603384BP in accordance with P.L. 103-160.

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	42693	52062	48593	42987	39922	42236	47463	49883	Continuing	Continuing
D313 Research Aircraft Systems	10504	3453	4975	3632	9949	16420	16987	18956	Continuing	Continuing
D391 Tractor Will	0	9400	6965	5190	995	1493	999	0	0	25042
D435 Aircraft Weapons	921	3115	2963	0	0	1990	5936	7981	Continuing	Continuing
D436 Rotary-Wing Controls and Rotors	7883	12557	21230	25655	21769	15226	15987	15464	Continuing	Continuing
D447 Aircraft Demonstration Engines	4435	5934	7158	8012	6811	6858	7494	7482	Continuing	Continuing
DA38 Starstreak	0	2959	0	0	0	0	0	0	0	2959
DB38 Tractor Cone	4758	0	597	0	0	0	0	0	0	5355
DB39 Advanced Distributed Simulations	12006	9605	0	0	0	0	0	0	0	21611
DB97 Aircraft Avionics Equipment	2186	5039	4705	498	398	249	0	0	0	13075

A. **Mission Description and Budget Item Justification:** The objective of this program element (PE) is to develop aeronautical technology for new and/or upgrades to DoD/Army Vertical Take-off and Landing (VTOL) airmobile systems. Helicopter rotors provide low disc loading as compared to the tilt rotor's intermediate disc loading and vertical lift jet engine's high disc loading. Low disc loading VTOL aircraft offer a practical solution to many of the DoD/Army's operational needs. Such aircraft, with their ability to operate below tree top level for Nap-of-the-Earth (NOE) missions, present significantly different analysis and design challenges from traditional fixed wing aircraft which fly at higher altitudes. The Army Aviation Science and Technology program's functional organization, with assistance from National Aeronautics and Space Administration (NASA) at three co-located activities, is the focal point for US efforts in rotorcraft technology. Technical areas include aeromechanics, aerodynamics, structures, propulsion, reliability and maintainability, safety and survivability, mission support equipment, aircraft system synthesis, aircraft subsystems, advanced helicopter analysis, flight simulation, aircrew-aircraft integration, aircraft weapons, aircraft avionics for command and control, air-to-air/air-to-ground communications, controls and displays, digital avionics and architectures, NOE navigation, mission planning, air traffic management and investigation and selective application of Integrated Product and Process Development (IPPD) techniques. These technologies are continuously being researched for applications to improve and correct deficiencies in current DoD/Army VTOL aircraft 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) and Army Modernization Plans, and DoD Project Reliance agreements. This program is dedicated to conducting proof-of-principle simulations, field demonstrations, and tests of non-system and system specific technologies to meet specific military needs and is therefore appropriately funded in Budget Activity 3.

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Work in this PE is performed by contractors including Georgia Institute of Technology, Atlanta, GA; McDonnell Douglas Helicopter Systems, Mesa, AZ; Boeing Helicopter Company, Philadelphia, PA; Loral Western Development Laboratories, San Jose, CA; Bell Helicopter Textron Incorporated, Ft. Worth, TX; Martin Marietta, Atlanta, GA, General Electric, Lynn, MA; Allied Signal Engines, Phoenix, AZ; Honeywell, Minneapolis, MN; Sikorsky, Stratford, CT; BDM International, Albuquerque, NM; MITRE, McLean, VA; Shorts Missile Systems, Belfast Northern Ireland, and CAE Electronics, Montreal, Canada.

Primary in-house developers of the technology under this program element include Simulation, Training and Instrumentation Command (STRICOM), Orlando, FL; Aviation and Troop Command (ATCOM), St. Louis, MO; Communications-Electronics Command (CECOM), Ft. Monmouth, NJ; Aeroflightdynamics Directorate, ATCOM, NASA Ames Research Center, Moffett Field, CA; Aviation Applied Technology Directorate, ATCOM, Ft. Eustis, VA; Structures Directorate, Army Research Laboratory (ARL), NASA Langley Research Center, Hampton, VA; and Vehicle Propulsion Directorate, ARL, NASA Lewis Research Center, Cleveland, OH. Related activities are performed by National Aeronautics and Space Administration.

This program adheres to DoD Project Reliance Agreements on Aeropropulsion and Air Vehicles (Rotary) with oversight and coordination provided by the Joint Directors of Laboratories; and Training Systems with oversight and coordination provided by the Training and Personnel Systems Science & Technology Evaluation Management Committee (TAPSTEM). Related concept exploration is conducted under PE 0602211A (Aviation Technology). Efforts under this PE transition and provide risk reduction for and lead into Demonstration/Validation and Engineering Development programs supported by PE 0603801A (Aviation - Advanced Development), PE 0604801A (Aviation - Engineering Development) and PE 0604270A (Electronic Warfare Development). In addition, this PE's deliverables provide technical support and technology transition to PE 0604223A (RAH-66 Comanche), PE 0604816A (Longbow), and PE 0203744A (Aircraft Modifications/Product Improvement).

The Army participates in and with the following groups, organizations and programs for total coordination: the DOD Tri-Service Joint Technical Coordination Group for Munitions Development and Aircraft Survivability; Acoustical Society of American Standards, Committee on Acoustics Group for Aerospace Research and Development; Aircraft Instruments and Aircrew Station Working Group; the NATO Military Agency for Standardization Air Armament Working Party; the Joint Integrated Avionics Working Group (JIAWG); Integrated High Performance Turbine Engine Technology (IHPTET) Steering Committee; the Air Armament Working Party of NATO; The Army's Combined Arms Weapon System (TACAWS) Executive Steering Committee and the Executive Steering Committee for the Rotorcraft Pilot's Associate (RPA) Program. This participation enables the gathering of technical information and assets in determining the joint use and standardization of airborne weaponization items. The Army Munitions Research and Development Committee, an organization within the Office of the Secretary of Defense, functions to establish Joint Service requirements and the development of air munitions. International related activities are the Technical Cooperation Programs with Australian, Canadian and United Kingdom governmen. and Defense Development Share Plans. Formal Memoranda of Understanding (MOUs) and Data Exchange Agreements (DEAs) with various friendly nations are actively pursued to allow technology information exchange. There is no unnecessary duplication of effort within the Army or Department of Defense.

Project D313 - Research Aircraft Systems: This project provides for technology demonstration in support of research for advanced rotors/controls, flight controls, airframes/structures, and drive trains. Technologies developed will be executed in three demonstrations: Manufacturing and Structures Technology for Efficient Rotorcraft (MASTER), Advanced Rotorcraft Transmission Phase II (ART-II), and Helicopter Active Control Technology (HACT). These will focus the enabling technologies for the National Transport Rotorcraft (NTR) to meet the cargo/transport and commuter needs of the military and civilian sectors, as well as technology insertion for other system upgrades. Focus is on technology to allow rotorcraft to meet the challenges from peacekeeping to the future battlefield.

FY 1994 Accomplishments: This is a classified program. Restructured to Project D391 in FY 95

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FY 1995 Planned Program:
- Design and demonstrate the benefits of applying fuzzy logic theory to rotorcraft digital flight control technology (2367)
- Perform ground and tethered initial testing of the Autonomous Scout Rotorcraft Testbed (ASRT) (1014)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (72)

FY 1996 Planned Program:
- Define MASTER structural configuration and requirements (1550)
- Select critical MASTER components for development, testing, and demonstration (1550)
- Complete flight testing and conduct ASRT demonstration (1875)

FY 1997 Planned Program:
- Develop MASTER tailored structural concepts and manufacturing approaches (1800)
- Develop MASTER repair concepts and techniques (822)
- Define ART-II requirements and conduct preliminary design (1000)

Project D391 - Tractor Will: This is a classified program restructured from Project D313.

Project D435 - Aircraft Weapons: This project demonstrates rotorcraft weaponization technologies utilizing an integrated system approach. Integration of advanced missile, rocket and gun system fire control, target acquisition and weapon system selection processes are demonstrated. This project supports Rotorcraft Pilot's Associate (RPA) program.

FY 1994 Accomplishments:
- Analyzed and developed target acquisition subsystem specifications as a part of RPA conceptual design activities (320)
- Analyzed and developed armament and fire control subsystem specifications as a part of RPA conceptual design activities (320)
- Completed specification and preliminary design of weapons and target acquisition models for RPA (281)

FY 1995 Planned Program:
- Develop specific knowledge acquisition approaches and techniques for weapons and target acquisition aspects of RPA mission operations (483)
- Continue development of weapons and target acquisition simulation models for RPA (724)
- Complete preliminary design of Attack Planner portion of RPA's Cognitive Decision Aiding Subsystem (CDAS) (1843)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (65)

FY 1996 Planned Program:
- Complete weapons and target acquisition knowledge development portion of mission operation as part of the RPA detailed design (550)

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603003A Aviation Advanced Technology

- Complete development of RPA weapons and target acquisition simulation models (500)
- Conduct detailed design of the CDAS Attack Planner for RPA (1913)

FY 1997 Planned Program: Project is not funded.

Project D436 - Rotary-Wing Controls and Rotors: The objective of this project is to demonstrate man-machine integration, rotors and control technology to provide enhanced helicopter pilotage capability, improved crew workload distribution, increased maneuverability/agility, with reduced vibration and maintenance. This is the primary project for the Rotorcraft Pilot's Associate (RPA) Advanced Technology Demonstration (ATD). It provides for the demonstration of rotorcraft crew stations utilizing knowledge-based information systems to develop Cognitive Decision Aiding (CDA) for crews. Advanced technology in information technology computing methods, sensors, displays, and controls are demonstrated to maximize combat helicopter mission effectiveness and survivability for day/night adverse weather operations. Provides for the demonstration of simulation capability to evaluate combined rotorcraft control and crew performance via virtual prototyping and Battlefield Distributed Simulation-Developmental (BDS-D). Beginning in FY 97, lessons learned from the ASRT will be applied to an effort to define the optimum approach to using an aircraft team of a manned helicopter and unmanned air vehicle (UAV) to perform Army aviation missions. The UAV will be capable of performing scout/reconnaissance assignments and alerting manned helicopters of "just ahead" situations. With state-of-the-art sensors, it will detect and identify targets, report location, and send real-time video to the aircrew and/or ground stations.

FY 1994 Accomplishments:

- Completed RPA conceptual design including system architecture, software sizing estimates, hardware/software mapping, subsystem specification refinement, mission scenario expansion, and total task allocation; initiated knowledge based acquisition session with scout attack and Special Operations Forces for mission planning and execution (2478)
- Completed Task Network Toolset and continued refinement of software tools necessary to manage and develop the information and knowledge base (876)
- Initiated specification and preliminary design of mission equipment models and 4-axis side arm controller necessary to support combined arms full-mission simulation (2412)
- Continued development of capabilities necessary to support Distributed Interactive Simulation (DIS) warfighting experiments planned in BDS-D environment (2117)

FY 1995 Planned Program:

- Complete RPA system hardware and software preliminary design and system build 1 (6884)
- Conduct knowledge acquisition session on scout/attack and Special Operations Forces mission (604)
- Develop engineering simulation environment necessary to support the high fidelity interactions between RPA system and the aircraft and its mission equipment (942)
- Continue full mission combined arms simulation development activity to include representation of the RPA baseline "Comanche-Like" system (1449)
- Conduct critical design of the Simulation Program for Improved Rotorcraft Integration Technology (SPIRIT) 4-axis side-arm controller and preliminary design of the airworthy helmet-mounted display (1931)
- Perform an initial RPA advanced mission equipment package (MEP) evaluation in the BDS-D simulation network (483)

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- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (264)

FY 1996 Planned Program:
- Complete RPA hardware detail design and software system builds 2,3,4; initiate fabrication, modification, and integration activities for the flight test vehicle (13711)
- Complete high fidelity engineering simulation environment that supports development and engineering evaluation of the RPA. Includes full fidelity mission equipment models that interface directly with RPA core architectures (1750)
- Continue knowledge acquisition collection and refinement for scout/attack and Special Operations Forces mission (770)
- Maintain and improve combined arms simulation capabilities through SPIRIT commitments (2000)
- Refine operational evaluation techniques and perform RPA system performance evaluations during concurrent software development activities (2999)

FY 1997 Planned Program:
- Complete knowledge acquisition collection activities and software detailed design; perform system builds 5&6; conduct software critical design review (8420)
- Conduct engineering and full mission simulation System Formal Evaluations I&II (6315)
- Perform subsystems integration, ground-based testing, and airborne validation in preparation for the FY 98 RPA system flight evaluation at Fort Hunter-Liggett (5464)
- Maintain and improve combined arms simulation capabilities through SPIRIT commitments (2000)
- Refine operational evaluation techniques and perform RPA system performance evaluations during concurrent software development activities in preparation for the FY 98 full system combined arm distributed simulation warfighting evaluations (3056)
- Initiate concept definition for aircraft team of a manned helicopter and a UAV with a ground station, to perform aviation missions (400)

Project D447 - Aircraft Demonstrator Engines: The objective of this project is to competitively perform design, fabrication and test of advanced technology engines and integrated components to demonstrate achievable improved performance levels for current and future DoD aircraft emphasizing Army unique requirements. The current/planned Joint Turbine Advanced Gas Generator (JTAGG) efforts are all fully coordinated/aligned with the phases/goals of the DoD Integrated High Performance Turbine Engine Technology (IHPTET) program and industry. IHPTET/JTAGG goals focus on reducing specific fuel consumption (SFC) and increasing the power to weight (P/W) ratio of turboshaft engines.

FY 1994 Accomplishments:
- Demonstrated JTAGG I+ turboshaft engine performance (2075)
- Conducted JTAGG I+ alternate fuels test, 30 hour gas generator durability test, and starter/generator operation verification in gas generator (960)
- Initiated JTAGG II demonstrator (1400)

FY 1995 Planned Program:
- Complete JTAGG II design (1835)
- Procure JTAGG II components (2028)

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- Initiate JTAGG II component tests (1946)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (125)

FY 1996 Planned Program:
- Complete initial JTAGG II component test (2158)
- Perform gas generator fabrication and build-up (3000)
- Initiate gas generator test (2000)

FY 1997 Planned Program:
- Complete final component final design (3010)
- Perform final component fabrication (3002)
- Perform final component tests (500)
- Initiate JTAGG fabrication and build-up (1500)

Project DA38 - Starstreak: The objective of this project is to investigate air-to-air (ATA) applications of the Starstreak missile on rotary wing platforms. Technical feasibility of the Starstreak missile integration on a rotary wing platform will be determined through analysis and flight tests. Missile system cost effectiveness will be performed as part of a preliminary assessment of the military worth of the Starstreak missile as an ATA self defense weapon.

FY 1994 Accomplishments: Project not funded.

FY 1995 Planned Program:
- Simulate Starstreak missile/rotorcraft integration concepts and analyze cost and military effectiveness issues (950)
- Design and fabricate missile/rotorcraft integration components and install on a testbed rotorcraft (1400)
- Substantiate safe launch conditions with separation flight testing (547)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (62)

FY 1996 Planned Program: Project not funded.

FY 1997 Planned Program: Project not funded.

Project DB38 - Tractor Cone: This is a classified program.

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Project DB39 - Advanced Distibuted Simulations: This project supports the Battlefield Distributed Simulation-Developmental (BDS-D) program and the Anti Armor (A2) Distributed Interactive Simulation (DIS) program. In FY 93, the A2 program was supported by PE 0603654A, Project D460. The BDS-D program simulation capabilities will be used for demonstrating and assessing advancements in distributed large scale, networked real-time, man-in-the-loop, upward compatible simulation architectures, and emerging tri-service/industry standards and methods for representing battlefield behaviors through use of selective levels of simulation fidelity and network participation. In FY 95, the BDS-D program is supported by PE 0602308A, Project AC90. The A2 program is intended to develop and demonstrate a verified, validated and accredited (VV&A) DIS capability to assess anti armor weapon system virtual prototyping, concept formulation, requirements definition, effectiveness evaluation, and mission area analysis on a combined arms battlefield at the Battalion Task Force or Brigade level. The results of this evaluation will support virtual prototyping effectiveness analysis, and make future weapon system improvements more timely, effective and affordable.

FY 1994 Accomplishments:

- Developed Verification, Validation and Accreditation (VV&A) plans for weapons systems supporting A2 program and developed detailed Integrated Engineering Plans for all experiments (1300)
- Initiated development of JAVELIN, NLOS, LOSAT, M2/M3A3+, Comanche, and Apache simulations and VV&A plans (6033)
- Conducted initial experiment of M1A2 Initial Operational Test and Evaluation (IOTE) (1777)
- Established baseline for modular semi-automated forces (SAFOR); provided SAFOR support to A2ATD; continued developmental research in support of BDS-D architecture (2396)
- Developed standards and integrated approach and models for interfacing Command, Control, Communications, Intelligence and Electronic Warfare (C3IEW) systems and C3IEW simulations to distributed combat/wargame simulations for digitizing the battlefield (500)

FY 1995 Planned Program:

- Link JANUS Semi-Automated Force model to BDS-D DIS and perform VV&A (308)
- Conduct DIS experiments using M1A2, M2/M3A3+, LOSAT, NLOS, RAH-66, and AH-64D virtual simulators and perform VV&A (6933)
- Conduct Rapid Force Projection Initiative DIS experiment using modular semi-automated forces LOSAT, NLOS, HUNTER, RAH-66, AH-64D, and JAVELIN simulations and perform VV&A (2162)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovative Research Program Reauthorization Act of 1992 (202)

FY 1996 Planned Program: Project not funded.

FY 1997 Planned Program: Project not funded.

Project DB97 - Aircraft Avionics Equipment: This project supports development and demonstration of advanced, integrated avionics equipment in support of aviation integration into the digitized battlefield. Evolving concepts in digital avionics will provide new functional capability in the areas of situational awareness, flight path guidance, position reporting and digital data transfer. Work in this project supports the RPA program.

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FY 1994 Accomplishments:

- Designed an integrated architecture that supports the data distribution requirements of the advanced avionics systems included in RPA (760)
- Developed and analyzed the communications, navigation, pilotage, and controls and displays subsystem specifications as part of RPA conceptual design activity (390)
- Conducted analysis of the RPA man-machine information transfer requirements and its impact on conceptual design (730)
- Initiated the specification and preliminary design of the communications, navigation, and pilotage subsystems simulation model (306)

FY 1995 Planned Program:

- Provide RPA mission equipment integration support in the areas of communications, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence (483)
- Conduct specific knowledge acquisition sessions on the communications, navigation, pilotage, and information transfer aspects of mission operation (346)
- Continue development of the communications, navigation, and pilotage simulation models (483)
- Complete preliminary design of the data fusion approach necessary to develop a digital representation of the available battlefield information (1207)
- Complete preliminary design of the Intelligence and Communications planner of the Cognitive Decision Aiding Subsystems (CDAS) (2414)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (106)

FY 1996 Planned Program:

- Provide RPA mission equipment integration support in the areas of communication, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence (824)
- Complete knowledge acquisition sessions on communications, navigation, and pilotage aspects of mission operation (450)
- Complete development of the communications, navigation, and pilotage simulation models (500)
- Conduct detail design and evaluation of the data fusion algorithms including direct stimulus from the mission equipment simulation models (1750)
- Conduct detail design of the CDAS Intelligence and Communications planners (1181)

FY 1997 Planned Program:

- Provide RPA mission equipment integration support in the areas of communication, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence (498)

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B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	41406	51350	67003	46274
Appropriated Value	41406	52062		
Adjustments to Appropriated Value	1287			
a. SBIR/STTR decrement (-640)				
b. Reprogramming total (1927)				
Current President's Budget Submit	42693	52062	48593	42987

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D313

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D313 Research Aircraft Systems	10504	3453	4975	3632	9949	16420	16987	18956	Continuing	Continuing

C. **Other Program Funding Summary** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Initial testing of the ASRT								X								
Complete flt test & conduct ASRT demo												X				
Initiate MASTER - define configuration & requirements; select components											X					
Initiate ART-II - define requirements & conduct preliminary design													X			

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE: February 1995
BUDGET ACTIVITY: 3 - Advanced Development	PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology		PROJECT: D391

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D391 Tractor Will	0	9400	6965	5190	995	1493	999	0	0	25042

C. **Other Program Funding Summary**: This is a classified program.

D. **Schedule Profile**: Classified program, therefore milestone events are not provided.

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D435

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D435 Aircraft Weapons	921	3115	2963	0	0	1990	5996	7981	Continuing	Continuing

C. **Other Program Funding Summary:** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Developed target acquisition subsystem specs to support RPA		X*														
Developed armament & fire control subsystem specs		X*														
Initiated spec & preliminary design of RPA weapons and target acquisition models			X*													
Complete RPA weapons and target acquisition simulation models										X						
Complete preliminary design of Attack Planner portion of CDAS								X								
Conduct detailed design of the CDAS Attack Planner for RPA									X							
Develop specific knowledge acquisition approaches and techniques for weapons and target acquisition aspects of RPA mission operations					X											
Complete wpns & target acq. knowledge development of mission operation												X				

*Denotes complete

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D436

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D436 Rotary-Wing Controls and Rotors	7883	12557	21230	25655	21769	15226	15987	15464	Continuing	Continuing

C. **Other Program Funding Summary:** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Completed RPA conceptual design		X*														
Completed task network toolset			X*													
Initiated specs & preliminary design of mission equipment models & 4-axis side arm controller				X*												
Conduct critical design of SPIRIT 4-axis side-arm controller & preliminary design of the airworthy helmet-mounted display						X										
Initiate fabrication, modification, and integration activities for the flight test vehicle												X				
Perform initial "Comanche-Like" versus RPA Advanced MEP evaluation in BDS-D simulation network								X								
Complete high fidelity engineering simulation environment for RPA											X					
Complete RPA system hardware and software preliminary design; System Build 1								X								
Complete RPA hardware detail design - Software system builds 2,3,4												X				
Perform system builds 5&6																X

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete knowledge acquisition collection activities and the software detailed design																X
Conduct software Critical Design Review																X
Refine operational evaluation techniques and perform RPA system performance evaluations														X		
Conduct engineering & full mission simulation System Formal Evaluations I&II																X
Perform subsystems integration, ground-based testing, and airborne validation																X
Initiate concept & tech definition for manned helicopter & semi-autonomous UAV team													X			

*Denotes complete

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: D447

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D447 Aircraft Demonstration Engines	4435	5934	7158	8012	6811	6858	7494	7482	Continuing	Continuing

C. **Other Program Funding Summary:** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demonstrated JTAGG I+ turboshaft engine performance				X*												
Conducted JTAGG I+ alternate fuels test, 30 hour gas generator durability test, and starter/generator operation verification in gas generator				X*												
Initiated JTAGG II demonstrator				X*												
Complete JTAGG II design						X										
Procure JTAGG II components								X								
Complete initial JTAGG component test										X						
Initiate Gas Generator Build											X					
Initiate Gas Generator Test												X				
Complete final component design														X		
Complete final Gas Generator component															X	
Conduct final components test																X

*Denotes complete

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BUDGET ACTIVITY: **3 - Advanced Development**

PE NUMBER AND TITLE: **0603003A Aviation Advanced Technology**

DATE: **February 1995**

PROJECT: **DA38**

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DA38 Starstreak	0	2959	0	0	0	0	0	0	0	2959

C. Other Program Funding Summary: See Paragraph A for related programs

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Simulate rotorcraft/missile launch effects								X								
Design integration components								X								
Fabricate components									X							
Install components on rotorcraft testbed										X						
Conduct launch separation and flight test and data analyses										X						

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: DB38

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DB38 Tractor Cone	4758	0	597	0	0	0	0	0	0	5355

C. **Other Program Funding Summary:** This is a classified program.

D. **Schedule Profile**: Classified program, therefore milestone events are not provided

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: DB39

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DB39 Advanced Distributed Simulations	12006	9605	0	0	0	0	0	0	0	21611

C. **Other Program Funding Summary:** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Developed Dead Reckoning methods and analysis simulation developers tool for DIS.		X*														
Developed Simulation Prototype Management Interface unit for DIS			X*													
Upgraded DIS Cell Interface and Adapter Units			X*													
Incorporated unclassified algorithms and data for generic weapons classes			X*													
Completed ModSAF 1.2/SAF 4.33 comparison study summary report				X*												
Developed Southwest Asia and Ft. Hood IOT&E area databases		X*														
Developed repeatable VV&A process for simulators		X*														
Developed SINCGARS radio simulator				X*												
Upgraded simulators for DIS capability				X*												
Further upgrades/development of simulators for DIS capability						X										
Perform VV&A on all simulators								X								

*Denotes complete

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603003A Aviation Advanced Technology

PROJECT: DB97

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DB97 Aircraft Avionics Equipment	2186	5039	4705	498	398	249	0	0	0	13075

C. **Other Program Funding Summary:** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Designed integrated architecture that supports data distribution requirements of RPA advanced avionics systems		X*														
Analyzed and developed RPA communications, navigation, pilotage, controls & displays subsystem specifications		X*														
Conducted analysis of RPA man-machine information transfer requirements		X*														
Initiated specs and preliminary design of RPA communications, navigation, and pilotage subsystems simulation model			X*													
Complete development of comms, navigation, & pilotage simulation models										X						
Complete preliminary design of data fusion approach								X								
Conduct detail design and evaluation of the data fusion algorithms									X							
Complete preliminary design of Intel & Comms planner of CDAS								X								
Conduct detail design of CDAS Intel & Communications planners											X					

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603003A Aviation Advanced Technology

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct specific knowledge acquisition sessions on the communications, navigation, pilotage, and information transfer aspects of mission operation						X										
Complete knowledge acquisition sessions on communications, navigation, and pilotage aspects of mission operation												X				

*Denotes complete

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603004A Weapons And Munitions Adv Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	26583	32122	18518	20558	23885	39577	48324	50380	Continuing	Continuing
DL94 Electric Gun Systems Demonstrations	10712	8767	0	0	0	2986	5996	5986	Continuing	Continuing
DL95 Landmine Warfare Development	0	3099	2978	2238	2477	4773	5496	5986	Continuing	Continuing
D43A Advanced Weaponry Technology Demonstration	12178	18454	10298	12162	10196	22028	19508	20576	Continuing	Continuing
D232 Advanced Munitions Demonstration	3693	1802	5242	6158	11212	9790	17324	17832	Continuing	Continuing

A. Mission Description and Budget Item Justification: The objective of this Program Element (PE) is to demonstrate advanced weapons and munitions technologies that will increase battlefield lethality and survivability. This PE funds several stand-off, anti-armor weapons demonstrations under the Rapid Force Projection Initiative (RFPI) to significantly increase the capability of early entry forces. The RFPI demonstrations funded within this PE include: the Precision Guided Mortar Munition (PGMM), Advanced Submunition Sensor Technology (ASST), and 155mm Light Weight Automated Howitzer (LAH). A new initiative in response to new threat information is the Direct Fire Lethality Program, the purpose of which is to significantly enhance anti-tank lethality by maximizing warhead/penetrator effectiveness, especially against new explosive reactive armors (which may appear as appliques) and against active protection systems. In the area of combat vehicle anti-armor munitions, advanced explosively formed penetrator warheads exploit technologies in explosives, liner materials, and demonstrate increased armor penetration through advanced warhead concepts. Under field artillery technologies, new cannon-fired smart munitions technologies with larger search area capabilities and enhanced fire control will be demonstrated to provide upgrade options for fielded systems. Technologies are being developed to demonstrate an artillery projectile capable of ranges in excess of 40 kilometers. Work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armaments Research and Development and Engineering Center, Picatinny Arsenal, NJ. This program adheres to Tri-Service Reliance Agreements on conventional air-surface weaponry with oversight provided by the Joint Directors of Laboratories. Work in this PE is related to and fully coordinated with efforts in PE 0602624A (Weapons and Munitions Technology), PE 0602618A (Ballistics Tech) and PE 0604802A (Weapons and Munitions-Engineering Development). This work is dedicated to conducting field demonstrations and tests of technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

Project DL94 - Electric Gun Systems Demonstration: This project utilizes pulsed electrical energy concepts and technologies to demonstrate the propulsion of hypervelocity projectiles. Electromagnetic (EM) technology will be demonstrated by this project. EM guns use an intense magnetic field to achieve velocities not obtainable by conventional means. There are two major efforts in the EM arena: Cannon Caliber EM Gun (CCEMG) system and the Focused Technology Program (FTP). The CCEMG is the joint Army and U.S. Marine Corps (USMC) program to develop EM gun component technologies with specific application to a more lethal cannon caliber (20-40mm) EM gun system. Several reviews by the Army and the Office of the Secretary of Defense revealed serious technical barriers to a large caliber electric

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armament demonstration and have caused the Army to restructure the program. Accordingly, the program will transition to the Army Research Laboratory and the Institute for Advanced Technology in FY 1996 (PE's 0601104A and 0602618A). The principle contractors on this effort are United Defense, Minneapolis, MN and Center for Electromechanics (CEM), University of Texas at Austin. The FTP program is developing generic EM technologies to support all mission areas. The principle contractors are Loral, Dallas, TX; Kaman Electromagnetics, Hudson, MA; SAIC, San Diego, CA; and CEM. A proof of principle test of advanced power supplies will be conducted in support of future EM development.

FY 1994 Accomplishments:

- Continued component design and fabrication phase and initiated single shot testing of Joint Army/USMC CCEMG program (3500)
- Continued Phase IIa, development and fabrication of pulse power concepts of the Focused Technology Program (3414)
- Developed and tested advanced EM integrated launch packages to demonstrate launchability of improved designs (1500)
- Developed new assembly procedures for pulsed power rotating machines and test/fire large and small caliber EM and Electrothermal Chemical guns/launch packages to verify performance effects on materials and computer models (1006)
- Continued development of components for pulsed power, launch and launch package technology to support tactical 9 megajoule (MJ) gun development (997)
- Completed high performance Electro-Thermal Chemical (ETC) tank gun program for 30mm ammo configuration (295)

FY 1995 Planned Program:

- Conduct CCEMG component and system design/fabrication/integration/testing. (3800)
- Conduct proof of principle tests of pulse power supply concepts of Focused Technology Program. (4608)
- Complete tests of full scale EM anti-armor projectiles at Kirkcudbright, UK test range to 1 km to verify flight stability and accuracy (175)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (184)

FY 1996 Planned Program: Project Not Funded

FY 1997 Planned Program: Project Not Funded

Project DL95 - Landmine Warfare Development: This project funds the Intelligent Mine Field (IMF) demonstration, which is an anti-armor weapon candidate under the Rapid Force Projection Initiative (RFPI). The IMF will demonstrate the flexibility and battlefield effectiveness of coordinated smart mine attack utilizing Artificial Intelligence (AI), decision aids, Automatic Target Recognition (ATR), intermine communication, and extended range command and control. Mines that can defeat targets over a wide area have a tremendous payoff, especially for light forces that are weight and space constrained when they deploy. Additionally, anti-tank features such as a high probability of kill provided by top attack and command and control (e.g., on/off capability) make such mines very effective force multipliers. The IMF will include advanced acoustic sensors to cue mines as well as to provide remote sensors for the RFPI "hunter/stand-off killer" concept. In-house efforts are accomplished by Armament Research Development and Engineering Center, Picatinny Arsenal, NJ.

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FY 1994 Accomplishments: Work performed in PE 0603606A, project D006. Restructured to project DL95 in FY 1995

FY 1995 Planned Program:
- Demonstrate common component modules which link Wide Area Mines (WAM) to create IMF (1017)
- Conduct initial testing of prototype Distributed Interactive Simulation (DIS)-compatible IMF simulator (1017)
- Perform detailed planning for IMF Advanced Technology Demonstration (ATD) (1000)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (65)

FY 1996 Planned Program:
- Conduct ATD, demonstrating IMF system end to end and target hand-off capabilities utilizing prototype IMF hardware and Pre-Planned Product Improvement (P3I) WAMs (2400)
- Finalize design for an enhanced DIS compatible IMF simulator (578)

FY 1997 Planned Program:
- Complete analysis of IMF ATD and issue report (100)
- Support RFPI integrated demonstration test planning (638)
- Fabricate prototype hardware to support RFPI (1500)

Project D43A - Advanced Weaponry Technology Demonstration: This project includes most of the stand-off weapons candidates for the Rapid Force Projection Initiative (RFPI) and lethality enhancements under the Direct Fire Lethality Program. Weapons demonstrations are vital to assessing new tactics and technologies for early entry forces to defeat armor. Collectively, weapons under RFPI constitute stand-off killer options for a "Hunter/Stand-off Killer" approach. The Precision Guided Mortar Munition (PGMM) demonstration will feature an extended range, top-attack, anti-armor capability for light forces. It will include assessments of both 81mm and 120mm non-developmental item candidates, and an evaluation of the operational potential for each item. Large footprint smart munition sensor technologies appropriate for MLRS will be evaluated. Fire control enhancements for towed howitzers, funded by congress, will be evaluated. A 105mm guided projectile with common seeker will be evaluated in FY 97. An extended range artillery (ERA) projectile (XM982) demonstration will move the Army closer to resolving its artillery range deficit. Most of the concepts to be demonstrated are candidates for technology insertions and many provide significant enhancement to early entry forces. In-house efforts are accomplished by Armament Research Development and Engineering Center, Picatinny Arsenal, NJ and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp (SAIC), McLean, VA; LTV Aerospace, Dallas, TX; Textron, Lowell, MA; Ferrulmatic, Inc., Totowa, NJ; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; Olin-Flinchbaugh, Red Lion, PA; Textron, Inc., Willington, MA; and TSI, Mesina Park, NM .

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FY 1994 Accomplishments:

- Static fired three 81mm PGMM warhead designs and issued 120mm PGMM Request for Proposal (1930)
- Integrated advanced PGMM fire control and 120mm weapon onto High Mobility Multipurpose Wheeled Vehicle for Dismounted Warfare Battle Lab and RFPI Early Version Demonstration (435)
- Initiated optimized Laser Radar (LADAR) sensor suite configuration designs for Advanced Sensor Submunition Technology (ASST) evaluation; selected and developed viable Identify Friend or Foe (IFF) concepts for ASST (942)
- Conducted Electro-rheological (ER) fluids demo for LAH application (357)
- Conducted flight testing of prototype XM982 ERA projectile with brassboard embedded fuze and cargo ejection at 50km range (4831)
- Tested insensitive explosives for performance/environmental requirements; developed insensitive explosive technology to support The Army Combined Arms Weapon System (TACAWS) (2464)
- Conducted loading studies of insensitive explosives for TACAWS/Javelin warheads (1219)

FY 1995 Planned Program:

- Complete 81mm PGMM warhead and projectile evaluation and determine user support; conduct 120mm PGMM critical component demonstrations and downselect; develop fire control software for PGMM ballistics and moving target algorithm (5438)
- Fabricate and test captive carry large footprint sensor suite configuration (3981)
- Define optimum towed howitzer advanced fire control unit development and evaluate Lightweight 155mm Howitzer in concert with US Marine Corps (1012)
- Demonstrate insensitive explosive technology for TACAWS/Javelin warheads (636)
- Continue ER fluids demonstration for LAH (1000)
- Initiate XM982 safety, reliability and live cargo testing (6000)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (387)

FY 1996 Planned Program:

- Conduct 120mm subsystem development and common seeker captive flight tests (2022)
- Miniaturize fire control components and investigate weapon mounting of azimuth reference device for PGMM (960)
- Continue concept development of selected 120mm PGMM design (1400)
- Continue large footprint captive carry test for sensor evaluation (2869)
- Procure and fabricate towed howitzer advanced fire control unit (3047)

FY 1997 Planned Program:

- Demonstrate 120mm PGMM extended range, conduct hi-G testing and complete system integration (3540)
- Integrate and demonstrate improved man-portable fire control system for 120mm PGMM (1201)

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- Complete large footprint captive carry test for sensor evaluation (2861)
- Complete fabrication and test towed howitzer fire control unit (3898)
- Design 105mm terminally guided projectile using common seeker (662)

Project D232 - Advanced Munition Demonstration: In the near term, this project demonstrates advanced warhead and cartridge concepts, utilizing novel explosively formed penetrators (EFP) and Shaped Charged designs, that can be applied to product improvements to fielded and developmental anti-armor munitions (e.g., Advanced Sensor Submunition Technology (ASST), Wide Area Mines (WAM), Smart Target Activated Fire and Forget (STAFF), 120mm Chemical Energy (CE) Cartridge and The Army Combined Arms Weapons System (TACAWS)). It advances warhead technology to enhance the lethality of smart projectiles by providing multi-role, multi-effect warheads capable of defeating point and area targets. Starting in FY 96, the Direct Fire Lethality Program will be conducted to enhance tank main armament Kinetic Energy (KE) penetrator lethality, especially against explosive reactive armor (ERA), demonstrate range and lethality enhancements for tank-fired smart munitions, and demonstrate technologies to defeat active protection systems. This project will fund demonstrations of advanced fuzes for near term munitions concepts. In-house efforts are accomplished by Armament Research Development and Engineering Center, Picatinny Arsenal, NJ and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp (SAIC), McLean, VA; LTV Aerospace, Dallas, TX; Textron, Lowell, MA; Ferrulmatic, Inc., Totowa, NJ; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; and Olin-Flinchbaugh, Red Lion, PA.

FY 1994 Accomplishments:
- Optimized design of multi-mode selectable warheads and initiated concept of dual liner EFP warheads for multi-mission capability against heavy or light armor targets (1000)
- Fabricated full scale selectable and dual liner EFP warheads and tested against heavy and light armor targets (725)
- Designed and fabricated promising KE precursor concepts and conducted 120mm tank gun launched tests (1968)

FY 1995 Planned Program:
- Continue to optimize grid design of selectable EFP and dual liner EFP warheads (808)
- Fabricate and conduct static test of selectable EFP warhead (781)
- Design combined effects warhead (175)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (38)

FY 1996 Planned Program:
- Demonstrate 25% increase in armor penetration in a SADARM-type warhead (2000)
- Evaluate warhead lethality against reactive range targets (622)

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- Fabricate KE precursor cartridge componentry for field demonstration against explosive reactive armor (2000)
- Design advanced warhead for STAFF lethality upgrade to defeat advanced armors (620)

FY 1997 Planned Program:

- Integrate, demonstrate, and transition the KE precursor technology to the PM Tank Main Armament Systems for XM829E3 (1569)
- Demonstrate 1km increase in effective range of tank-fired smart munition (600)
- Develop warhead/fuzing effective against countermeasured active protection systems (1139)
- Design/develop enhanced STAFF EFP warhead for a potential Pre-Planned Product Improvement (800)
- Initiate subsystem development of a GPS translator and G-Hardened Receiver for Low Cost Competent Munitions (LCCM) (2000)

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	27269	25562	25971	28519
Appropriated Value	27269	32122		
Adjustments to Appropriated Value	-686			
a. SBIR/STTR decrement (-421)				
b. Reprogrammed (-265)				
Current President's Budget Submit	26583	32122	18518	20558

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603004A Weapons And Munitions Adv Technology

PROJECT: DL94

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DL94 Electric Gun Systems Demonstrations	10712	8767	0	0	0	2986	5996	5986	Continuing	Continuing

C. **Other Program Funding Summary** See Paragraph A for related programs

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demonstrate EM launchability				X*												
Complete ETC 30mm gun program				X*												
Complete EM anti-armor projectile test							X									
Demonstrate Cannon *Caliber technology*								X								
Demonstrate FTP technology concepts								X								

* Denotes a completed effort

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603004A Weapons And Munitions Adv Technology

PROJECT: DL95

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DL95 Landmine Warfare Development	0	3099	2978	2238	2477	4773	5496	5986	Continuing	Continuing

C. **Other Program Funding Summary** See Paragraph A for related programs

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demonstrate common component modules which would link WAMs to create IMF							X									
Complete IMF ATD												X				
Complete analysis of IMF ATD report													X			

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603004A Weapons And Munitions Adv Technology

PROJECT: D43A

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D43A Advanced Weaponry Technology Demonstration	121/8	18454	10298	12162	10196	22028	19508	20576	Continuing	Continuing

C. Other Program Funding Summary See Paragraph A for related programs

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Issue 120mm PGMM RFP			X*													
Demonstrate IM technology (TACAWS)				X*												
Demonstrate 120mm PGMM critical component technology								X								
Demonstrate IM technology for TACAWS/Javelin warheads								X								
Complete XM982 projectile flight tests										X						
Complete development of advanced fire control for the 155mm towed howitzer												X				
Complete 155mm towed howitzer advanced fire control demonstration																X

* Denotes a completed activity

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603004A Weapons And Munitions Adv Technology

PROJECT: D232

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D232 Advanced Munitions Demonstration	3693	1802	5242	6158	11212	9790	17324	17832	Continuing	Continuing

C. **Other Program Funding Summary** See Paragraph A for related programs

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete EFP warhead and KE precursor design concepts				X*												
Complete EFP warheads and KE precursor technology demonstrations								X								
Complete design of combined effects warhead										X						
Statically demonstrate STAFF dual liner EFP warheads															X	
Demonstrate STAFF range increase																X
Demonstrate Advanced KE Precursor for EMD transition to KE tank round																X

* Denotes a completed activity

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603005A Cmbt Vehicle And Automotive Adv Tech

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	39318	61346	30616	32570	35719	64016	70307	69902	Continuing	Continuing
D221 Combat Vehicle Survivability	10088	14231	11429	9263	9822	10350	10592	10375	Continuing	Continuing
A340 Producibility Technology	0	0	0	1472	2913	3321	4758	5654	Continuing	Continuing
D440 Advanced Combat Vehicle Technology	20867	31660	15554	15515	11834	33423	32974	30927	Continuing	Continuing
D441 Combat Vehicle Mobility Technology	2034	2282	2637	4329	4975	9955	12990	12969	Continuing	Continuing
D497 Combat Vehicle Electronics	6329	10214	996	1991	6175	6967	8993	9977	Continuing	Continuing
D502 HAECO II	0	2959	0	0	0	0	0	0	0	2959

A. Mission Description and Budget Item Justification: This program demonstrates the feasibility and operational potential of technologies which contribute to continued upgrades of currently fielded combat vehicles and future ground combat and tactical systems. It places emphasis on solutions to post-Cold War deficiencies, providing opportunities for more deployable, survivable, horizontally integrated and lethal power projection capabilities than are currently available. The technology areas supported by this program element include: survivability, mobility, intra-vehicular electronics and digitization, and integration of diverse vehicle technologies developed by the Army, other DoD laboratories and industry. This program element provides the bulk of efforts necessary to execute and integrate a focused set of Advanced Technology Demonstrations (ATDs) designed to address critical technical barriers to making future heavy forces more deployable and future light forces capable of defeating heavy, conventional forces. Prospects for a smaller future Army with fewer forces deployed overseas, combined with growing regional instability, make power projection of forces with decisive advantages an imperative. Initiatives conducted under this program element that support future land combat on the horizontal battlefield include: the introduction of composite materials to reduce the weight of ground vehicle structures and armor; the demonstration of fabrication and assembly process models for composite structures; integrated survivability (e.g., threat sensors and countermeasures such as jammers, obscurants and decoys); combat vehicle crew size reduction through automation of crew functions and better crew/vehicle integration; advanced mobility technologies to improve agility, reduce propulsion system size and weight, and decrease operation and support costs; implementation of a low cost, non-developmental advanced combat vehicle electronics and open/commercially based electronics architecture with digitized vehicle sub-systems, modification of a non-developmental vehicle to serve as a "hunter". Work in this program element is consistent with the resource constrained Army Science & Technology Master Plan (ASTMP), Science and Technology Objectives (STOs) and the Army Modernization Plan. This program is managed primarily by the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC). This program adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles, with oversight and coordination provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with PE 0602601A (Combat Vehicle and Automotive Technology) and contains no unwarranted duplication of effort among the

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Military Departments. This program is dedicated to conducting field demonstrations and tests of technologies to meet specific military needs and is therefore properly placed in Budget Activity 3.

Project D221 - Combat Vehicle Survivability: This project demonstrates survivability technologies in a systems integration laboratory (SIL), field experiments, vehicle integration and vehicle experiments that have been transitioned from exploratory development. Emphasis is placed on the Hit Avoidance advanced technology demonstration (HA ATD) technologies to provide hemispherical protection, along with the controlling software that will allow them to be integrated as an effective subsystem into ground vehicle systems. The combined technology will provide light weight protection against threat precision guided and smart weapons. This approach provides protection from top attack threats at a lighter weight than could be provided by additional armor. The HA ATD consists of a system integration laboratory (SIL) for component integration and threat countermeasure simulation, followed by a vehicle demonstration of hemispherical protection. It will provide hardware performance and modeling predictions for a cost effective, operationally optimal suite of threat sensors and countermeasure devices. It will demonstrate a near term active protection system to physically disrupt smart and anti-tank guided missile (ATGM) threats. Hit Avoidance technologies will provide the basis for the digitization of threat information on the battlefield. Coupled with other combat vehicles assets, force protection capabilities could then be realized. Survivability technologies that are integrated and demonstrated under this project include those transitioned from the following exploratory developmental programs; active protection countermeasure technology development (PE 0601102A); sensors and countermeasures (PE 0602270A). Alternative fire extinguishing agents that are non-ozone depleting are needed to maintain current readiness levels and combat vehicle survivability. This effort supports dual use technology begun under the Strategic Environmental Research and Development Program. This program includes funding in FY 1995 to evaluate non-ozone depletion substances. Starting in FY 1996, this program appears under PE 0602601A.

FY 1994 Accomplishments:

- Completed Guardian Study of hit avoidance technologies to assess combat worth, risk, cost and affordability of hit avoidance technologies, to define and focus the scope of HA ATD (591)
- Demonstrated threat sensors and countermeasures against top attack threats (8500)
- Performed top attack protection technology assessments for Advanced Field Artillery System (997)

FY 1995 Planned Program:

- Award contract for integrated defense system (IDS) for HA ATD system integration laboratory (SIL) (4111)
- Initiate adaptation of active protection (physical disrupt) against top attack and horizontal smart threats (2500)
- Conduct field evaluation to determine applicability of laser countermeasures for combat vehicle applications (1598)
- Continue contract to develop high resolution hit avoidance engineering models for performance analysis (1000)
- Modify combined arms and support task force evaluation model (CASTFOREM) to better represent smart weapons and electronic warfare (EW) countermeasures (500)
- Conduct integration, crew performance and toxicity testing on environmentally acceptable fire extinguishing agents (4223)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (299)

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FY 1996 Planned Program:

- Implement HA ATD SIL testing; determine HA ATD system architecture performance (6000)
- Adapt laser countermeasure devices for integration into ground combat vehicles (500)
- Continue development of model and simulation architecture (1200)
- Optimize design and initiate fabrication of active protection concept for threats ranging from top attack to smart horizontal attack munitions (3329)
- Perform force-on-force modeling on revised CASTFOREM to update Guardian EW cost effectiveness study (400)

FY 1997 Planned Program:

- Integrate active protection into HA ATD SIL (800)
- Integrate hit avoidance hardware and software into the HA ATD vehicle and demonstrate (4000)
- Conduct HA ATD advanced warfighting experiment (AWE) (1463)
- Demonstrate near term active protection system in field experiment (3000)

Project D340 - Producibility Technology: This project addresses technology problems associated with the fabrication of affordable systems. As new materials and processes are introduced, this issue takes on added importance. This project will: evolve and validate fabrication and assembly process models which detail the individual sequence of activities from receipt of raw materials to final assembly and inspection; adapt the product data exchange standard for use with the class of composite materials most suitable for manufacturing ground vehicles, thus providing the basis for automated software-based trade-offs between materials, design configurations, process planning and cost estimating; and conduct true concurrent engineering and virtual prototyping of major ground vehicle composite structures. Producibility tools will be used to conduct analyses and tradeoff studies in support of the composite armored vehicle advanced technology demonstration (CAV ATD).

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program:

- Develop the global architecture required to run the process models (400)
- Evolve fabrication and assembly process models (600)
- Validate analytic tools for the CAV ATD (472)

Project D440 - Advanced Combat Vehicle Technology: This project demonstrates the operational potential, technical feasibility and maturity of advanced combat vehicles technologies for potential product improvements and for the next generation of combat vehicles. The objectives are to demonstrate innovative combat vehicle

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configurations, technologies and integration techniques through hardware technology demonstrations, computer simulation and full-scale mock-ups, thereby accomplishing more rapid transition of advanced technologies to systems applications. All demonstrations include User and Developer participation in a field or laboratory environment. Efforts are focused on ATDs which examine technologies applicable to lighter weight and more survivable systems that offer significantly improved deployability over currently fielded combat vehicles. This project funds two major initiatives: continuation of the CAV ATD to demonstrate use of advanced composite materials for ground vehicles, and a modified, non-developmental item for a light vehicle to perform as "hunter" for the Rapid Force Projection Initiative (RFPI) "hunter/stand-off killer" concept. The CAV ATD will demonstrate a vehicle structure made of composite materials with advanced lightweight armor technology which can significantly reduce weight while improving survivability. Many issues, such as automotive durability, ability to withstand weapon firing shock, manufacturing methods and technology, repairability, ballistic performance, and nondestructive testing, remain to be resolved before composite technology can be transitioned to ground combat vehicle systems. Effective, manned sensor platforms using a modified non-developmental vehicle, is a key element of the RFPI. This project is the Army's complete vehicle platform integration activity and provides the mechanism to transition all of the promising ground system technologies to vehicle project managers for development. Vehicles supported include, but are not limited to, the Abrams tank, tank upgrades, future tanks, the M2/M3 Bradley, future scout vehicle, tactical trucks, including HMMWV, and specialty vehicles for combat engineers, early entry, special operations, drug enforcement, combat service support and logistics, and peacekeeping operations. United Defense, Limited Partnership, San Jose, CA is the prime contractor for the CAV ATD.

FY 1994 Accomplishments:

- Awarded a contract for the design and fabrication of CAV ATD vehicle and ballistic test hull to demonstrate a light weight composite material/structure approach for armored combat vehicles (7776)
- Developed preliminary design and interface control for CAV demonstration vehicle through the Integrated Product and Process Development (IPPD) process (3732)
- Developed advanced composite manufacturing concepts, vehicle concepts and simulation tools for the CAV demonstration vehicle (3405)
- Performed coupon and component tests of advanced armors and composite structural configurations to validate the contractor's design approach (1786)
- Initiated surrogate Hunter vehicle for RFPI demonstrations (1585)
- Acquired Hunter simulator to permit force-on-force simulations (340)
- Procured multispectral applique camouflage for low cost Hunter signature reduction evaluation (399)
- Performed alternative Hunter chassis requirements analysis (394)
- Procured, fabricated and began integration of the hardware for the RFPI Electronics systems integration laboratory (1450)

FY 1995 Planned Program:

- Develop minimum weight CAV ATD vehicle detailed structural design based on FY 1994 preliminary design efforts, simulations and coupon testing (12871)
- Integrate and validate advanced composite vehicle concepts and simulation tools into the virtual prototyping environment (3302)
- Perform material, structural subsystem and full scale quarter section tests including ballistics, mechanical and chemical testing to optimize structural configuration and validate simulations and manufacturing methods (3350)
- Procure functional sub-components to support the CAV ATD vehicle (8946)

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- Develop multi-spectral applique camouflage and construct initial Hunter force-on-force simulations and deliver a virtual prototype simulator to Dismounted Battlespace Battle Lab (1348)
- Modify a HMMWV for a RFPI Hunter vehicle concept (1250)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (593)

FY 1996 Planned Program:

- Using advanced manufacturing techniques, fabricate a minimum weight composite vehicle structure for the CAV ATD vehicle and one additional hull structure for structural and ballistic tests (4372)
- Demonstrate and validate optimized composite interface of automotive, crew and weapon station (2850)
- Perform advanced composite material and complex structural tests to validate design, models/simulations and manufacturing methods (3260)
- Perform a Battle Lab Warfighting Experiment (BLWE) with soldiers to verify battlefield repairability of composites (862)
- Develop vehicle concepts and simulation tools to provide the design methodology for applying composites to future military vehicles (3445)
- Integrate the scout sensor suite (or surrogate) on Hunter vehicle and conduct automotive testing (765)

FY 1997 Planned Program:

- Perform 105 mm weapon firing test, automotive performance test and a 6000 mile durability test on CAV ATD vehicle (8908)
- Validate virtual prototyping and new development methodologies for future Army programs (1120)
- Validate concepts and simulations to design, develop and manufacture future composite ground combat vehicles (2570)
- Prepare a composite structure design guide for interface control documents and technology transfer documents for composite combat vehicles (1503)
- Perform a BLWE with soldiers verifying the air deployment of the composite vehicle (608)
- Complete modified HMMWV Hunter vehicle (806)

Project D441 - Combat Vehicle Mobility Technology: This project demonstrates mobility technology (suspension , track, engines, transmissions, and auxiliaries) vital for lighter, more deployable ground combat vehicles. It funds an advanced mobility technology demonstration in several independent demonstrations. The principal elements of the mobility demonstration are active suspension, electric drive, and light weight track. Military requirements for vehicle mobility are unique because of (1) a need for a stable, smooth ride at high speeds (greater than 20 mph) over rough, cross country terrain (off-road), (2) a need for the mobility components to be as small and as light as possible in order not to detract from the vehicle's primary, war-fighting mission, and (3) armor and signature requirements complicate the engine air intake and exhaust systems. High speed is required to accomplish the maneuver-dominant warfare envisioned in the Air-Land battle doctrine. A smooth ride is necessary for weapon targeting on the move and for crew comfort and endurance, which are features embedded in our doctrine. The lighter and smaller vehicles are necessary for enhancing deployability and lessening the logistics burden (fuel), but will significantly degrade ride performance and mobility limits without new mobility technology advances. For the next decade, the mobility thrusts required to compensate for smaller and lighter systems are: electric drive (small internal propulsion size and weight), active suspension (high speed on rough terrain), and light weight track (reduced system weight).

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FY 1994 Accomplishments:

- Designed electric drive components for use in combat vehicles (200)
- Fabricated suspension test bed and integrated dynamic track tensioner and external suspension system with lockout and height control (750)
- Conducted laboratory demonstration of semi-active external suspension components (250)
- Evaluated high temperature diesel engine lubricants and components (834)

FY 1995 Planned Program:

- Conduct laboratory comparison of advanced variable gap and advanced induction electric motor sets (1120)
- Modify Bradley Fighting Vehicle System (BFVS) hull for semi-active suspension for mobility technology demonstrator (TD) (574)
- Demonstrate suspension test bed with dynamic track tensioner and external suspension system with lockout and height control (540)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (48)

FY 1996 Planned Program:

- Install and test semi-active suspension on mobility TD (694)
- Install and test band track on baseline BFVS vehicle (250)
- Install and test band track on mobility TD with the semi-active suspension (375)
- Award contract to develop integrated electric propulsion unit for 30-ton weight class combat vehicle (868)
- Award contract to develop compact, high power, high temperature power electronics (450)

FY 1997 Planned Program:

- Award contract for wheeled vehicle electric suspension and integrate into test bed vehicle (950)
- Award contract for 20-40 ton tracked vehicle active suspension and integrate into test bed (1225)
- Develop and fabricate compact, high power, high temperature power electronics (1100)
- Demonstrate integrated electric propulsion unit in 30-ton vehicle test bed (750)
- Assess advanced light weight band track concepts suitable for 40+ ton ground combat vehicles (304)

Project D497 - Combat Vehicle Electronics: This project demonstrates the electronic and digitization technologies required to integrate advanced computing architectures and control data/power distribution within ground combat vehicles. This project is essential to achieve horizontal technology integration on the future digitized battlefield. This project also funds improvements in ground vehicle soldier machine interfaces (SMI) by the designing advanced crew station configurations for current combat vehicle upgrades and a future vehicle design with a 50% crew workload reduction. This project funds the Crewman's Associate advanced technology demonstration (CA ATD). Using soldier-in-the-loop simulation and modeling, CA ATD will demonstrate significant crew station performance enhancements over existing combat vehicles through the application of advanced interface technologies (e.g., helmet mounted displays, panoramic displays, voice interfaces). Simulation will be used to allow the User to continuously influence and evaluate the capabilities of the CA ATD crew station design and to refine overall system requirements prior to

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building more extensive hardware prototype and vehicles. This effort coordinates the SMI and electronics requirements of several ATDs (Hit Avoidance, Target Acquisition, and Combined Arms Command and Control) to insure effective integration of their technologies. This project funds the development of the next generation of Standard Army VETRONICS Architecture (SAVA III). This will be a nonproprietary open systems electronics integration architecture based on commercially available standards and components. This architecture improves upon the current state-of-the-art ground vehicle integration architectures providing a data transfer rate 100 times greater than the current architecture being used in today's digitized combat vehicles. This improved data rate will be necessary to process the increased amount of data and imagery from advanced digital displays, digital combat identification, advanced sensors and the digitized battlefield. This architecture is critical to the integration of advanced sensors and countermeasures, advanced target acquisition technologies and digital communications into future combat vehicles. Both CA ATD and SAVA III are required to support Program Executive Office Armored Systems Modernization (PEO ASM) Preplanned Product Improvement (P3I) opportunities for the existing fleet (e.g., Abrams, Bradley), contribute to Advanced Field Artillery System development, and support future combat vehicles such as the future scout vehicle.

FY 1994 Accomplishments:

- Conducted M1A2 crew task analysis to establish baseline and completed definition of task aids for CA ATD (225)
- Initiated a design of a crew station with a 50% crew workload reduction for the CA ATD (2804)
- Implemented design of hardware and software for CA ATD crew station simulator (1500)
- Initiated integration of CA ATD reduced workload crew station into simulator (1800)

FY 1995 Planned Program:

- Complete crew station design for 50% crew workload reduction (2644)
- Complete crew station design for Abrams upgrade for improved SMI to digitized battlefield (1250)
- Fabricate and integrate crew station simulator hardware and software to measure crew workload reduction (3860)
- Conduct M1A2 Battle Lab Warfighting Experiment (BLWE) experiments to establish baseline reference data (1000)
- Conduct BLWE under dynamic conditions to analyze crew station interfaces under simulated warfighting conditions (400)
- Implement design and development of an open electronics architecture, using commercial standards, for future vehicle programs (850)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (210)

FY 1996 Planned Program:

- Conduct two BLWE's to demonstrate an improved SMI for an upgrade to the Abrams tank and crew station with 50% workload reduction (800)
- Complete Crewman's Associate Final Test/Simulation Report (100)
- Complete Crewman's Associate ATD program (96)

FY 1997 Planned Program:

- Continue development of open ground vehicle electronic architecture, based on commercial standards, which provides performance improvements 100 times greater than current combat vehicle architectures (1141)

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- Demonstrate improvements in ground vehicle electronics integration architecture performance in a laboratory/simulation environment (250)
- Provide critical support to User community to integrate the performance improvements into the Distributed Interactive Simulation (DIS) environment to enable the User to evaluate the warfighting enhancement provided by these improvements (600)

Project D502 - HAECO II: This Congressionally-directed projects calls for the further development and delivery for test of two Hope - Anderson Engine Company (HAECO) engines in the 400 to 600 horsepower range for potential ground or air vehicle use. HAECO is promoting a hybrid engine that uses both diesel engine and gas turbine elements. This concept and design is the property of the HAECO and has previously been explored by the Army. The Army will contract with HAECO to complete development of two engines for delivery to the Army for testing at the U.S. Army Tank-Automotive and Armaments Command.

FY 1994 Accomplishments: Project not funded

FY 1995 Planned Program:
- Noncompetitively procure and test two HAECO combined cycle engines in the 400 to 600 HP range (2747)
- Evaluate the contractor's development progress (150)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (62)

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	39044	59414	44860	55535
Appropriated Value	39044	61346		
Adjustments to Appropriated Value (Total PE)	+274			
a. SBIR/STTR decrement (-604)				
b. Reprogramming Total (+878)				
Current President's Budget Submit	39318	61346	30616	32570

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BUDGET ACTIVITY: 3 - Advanced Development

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PROJECT: D221

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D221 Combat Vehicle Survivability	10088	14231	11429	9263	9822	10350	10592	10375	Continuing	Continuing

C. Other Program Funding Summary See paragraph A.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Completed Top Attack Demo			X*													
Hit Avoidance ATD Contract Award						X										
System Integration Laboratory Demonstration													X			
Active Protection Field Experiment													X			
Integrate HA onto Test Vehicle															X	
Advanced Warfighting Experiment																X

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603005A Cmbt Vehicle And Automotive Adv Tech

PROJECT: A340

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A340 Producibility Technology	0	0	0	1472	2913	3321	4758	5654	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Award Contract for Fabrication and Assembly Process Models														X		

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603005A Cmbt Vehicle And Automotive Adv Tech

PROJECT: D440

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D440 Advanced Combat Vehicle Technology	20867	31660	15554	15515	11834	33423	32974	30927	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
CAV ATD Start of Work Meeting		X*														
CAV Design Progress IPR			X*													
CAV System Requirements Review					X*											
CAV Preliminary Design Review						X										
CAV Critical Design Review								X								
CAV Hull Delivery for Component Integration										X						
CAV Repairability Demo											X					
CAV Durability & Automotive Performance Testing													X			

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PROJECT: D441

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D441 Combat Vehicle Mobility Technology	2034	2282	2637	4329	4975	9955	12990	12969	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Completed Evaluation of High Temp Diesel Engine Lubes/Components				X*												
Lab Demo Electric Motors								X								
Demonstrate 30T Integrated Electric Propulsion Unit																X
Lab Demo Semi-Active Suspension				X*												
Demonstrate Advanced Suspension Test Bed								X								
Semi-Active Suspension Test Bed Demo												X				
Develop Active Suspension Test Bed																X
Fabricate Wheeled Vehicle Electric Suspension Test Bed																X
Demo BFVS Band Track												X				

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PROJECT: D497

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D497 Combat Vehicle Electronics	6329	10214	996	1991	6175	6967	8993	9977	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete Advanced Crew Station Designs							X									
Complete Crewman's Associate ATD Program										X						
Define SAVA III Architecture						X										

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PE NUMBER AND TITLE: 0603005A Cmbt Vehicle And Automotive Adv Tech

PROJECT: D502

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D502 HAECO II	0	2959	0	0	0	0	0	0	0	2959

C. Other Program Funding Summary See paragraph A

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Take Delivery of Two Engines								X								

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603006A Cmd, Cntrl And Comm Adv Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	7786	16829	16922	20885	17866	19219	17436	16828	Continuing	Continuing
D247 Tactical C4 Technology Integration	7786	7887	5570	8148	8315	13347	11990	11281	Continuing	Continuing
D257 Digital Battlefield Communications	0	8698	10854	12339	8954	5573	4996	5098	Continuing	Continuing
D592 Space Applications Technology	0	244	498	398	597	299	450	449	Continuing	Continuing

A. **Mission Description and Budget Item:** This program element consist of three projects that will advance command, control, and communications (C3) technology to provide the soldier with high quality real-time battlefield information and integrate space technologies into Army tactical applications. The Tactical C4 Technology Integration project provides software application development demonstrations, communications system integration and prototype products for distributed, mobile, secure, fully automated spread spectrum radio networks with measures to enhance the survivability, efficiency and efficacy of Army tactical command, control, communications and computer (C4) systems. This program specifically addresses Joint Service demonstrations coordinated through the Joint Directors of Laboratories (JDL) Technology Panel for C4 and provides key demonstrations of systems integration across the Army's battlefield functional areas. The Survivable Adaptive System (SAS) technology demonstration will provide multimedia internetworked communications while on-the-move (OTM) with commercial standard gateway connectivity to both high-speed and legacy communications assets. This program also tests and evaluates net radio, common user, and distributed communications equipment and automated spectrum management aids which have potential to solve user needs; tests and evaluates equipment deficiencies; and provides critical future capabilities and supports new radio development and evaluation, in conjunction with the Advanced Research Projects Agency (ARPA) and the Air Force (AF). The Digital Battlefield Communications project will support the Army's battlefield digitization effort by demonstrating technology to integrate communications hardware and software capable of providing seamless communications for the digitized battlefield to meet emerging requirements for high-capacity/OTM information exchange and leading to a Battlefield Information Transmission System (BITS) for Force XXI. The Space Applications Technology project will demonstrate novel applications of space assets for Army missions and support requirements definition. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this program element is related to and fully coordinated with efforts in PE 0602782A (Command, Control & Communications Technology), PE 0203740A (Maneuver Control System), PE 0203726A (Advanced Field Artillery Tactical Data System), PE 0602783A (Computer & Software Technology), PE 0602702E (Tactical Technology), and PE 0603789F (C3I Technology Development) in accordance with the ongoing Reliance Joint planning process. Efforts under Projects D247 (Tactical C3 Technology Integration) and D257 (Digital Battlefield Communications) are performed primarily by the US Army Communications-Electronics Research, Development and Engineering Center (CERDEC), Space and Terrestrial Communications Directorate, Fort Monmouth, NJ. Contractors include: SRI International, Menlo Park, CA; Mitre Corporation and Booze-Allen and Hamilton, Eatontown, NJ; Hazeltine, Greenlawn, NY; Rockwell International, Richardson, TX; and Jet Propulsion Laboratories, Pasadena, CA. Work under D592 (Space Applications Technology) is managed primarily by the U.S. Army Space and Strategic Defense Command (USASSDC), Alexandria, Va. Work in this program element is dedicated to conducting field demonstrations and tests of technologies to meet specific military needs and is correctly placed in Budget Activity 3.

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Project D247 - Tactical C4 Technology Integration: This project develops computer and communications (COMM) systems using commercial standard hardware and software to support battlefield decision making for the five battlefield functional areas of maneuver. It includes the Survivable Adaptive Systems technology demonstration. These efforts support evolving Army requirements for automated, real-time, digital information transfer, and the development and demonstration of COMM systems needed for the Combined Arms Command and Control (CAC2) program. This project also performs development of ultra-high frequency (UHF) satellite communications (SATCOM) on-the-move (OTM), interfaces mobile UHF SATCOM radios to Combat Net Radio (CNR) using commercial standard packet data protocols, and is developing multiband, multimode radio (MBMMR) technologies as part of the Joint Service "Speakeasy" program with the Air Force and the Advanced Research Projects Agency (ARPA).

FY 1994 Accomplishments:

- Began definition of future architecture for seamless tactical communications (1235)
- Delivered exploratory development model (EDM) of a multiband, multimode radio (MBMMR) and demonstrated reconfigurability and multi-waveform capabilities. This is a Joint Service effort with ARPA/AF lead (1234)
- Conducted laboratory tests and demonstrations of wireless, fiber optic local area network (LAN) and network management techniques for Survivable Adaptive Systems (SAS). Established enhanced COMM capability within field application with SAS technology (2340)
- Developed scenario to integrate SAS technologies into advanced warfighting experiment (AWE) to support use of advanced networks for enhanced command and control on-the-move (985)
- Used ported software algorithms to conduct voice-interoperability demonstration with battalion-and-below command and control hardware and software in conjunction with the user (1257)
- Performed C3 OTM experiments by integrating commercial transmission control protocols (TCP)/internetwork protocols (IP) and SAS technology products for warfighter evaluation (635)

FY 1995 Planned Program:

- Conduct laboratory demonstration of wideband (high capacity) wireless LAN to handle Ethernet, voice, and fiber optic data distribution interface for SAS (2190)
- Conduct laboratory test of all SAS technologies to demonstrate interoperability and survivability of communications systems. Conduct warfighting demonstration encompassing all SAS technologies (1725)
- Develop new circuit/packet features of target wide area communications/radio wire integration to determine feasibility and applicability of future enhancements to communication peripherals (813)
- Incorporate technology upgrades to multiband multimode radio (MBMMR) engineering prototypes (2300)
- Integrate battalion and below command and control technology into horizontal integration initiative (707)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (152)

FY 1996 Planned Program:

- Develop specifications/documentation for objective communication systems management and control in support of CAC2 (2227)

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- Demonstrate SATCOM on-the-move (OTM) airborne relay (693)
- Continue development of Speakeasy Phase 2 MBMMR engineering prototypes and test modifications to software/hardware for adequate emulation of waveforms (2050)
- Integrate speech recognition technology, natural language processing, contextual knowledge extraction and world knowledge processing to demonstrate "intent understanding" system and support CAC2 (600)

FY 1997 Planned Program:

- Integrate adaptive high frequency applique software; modify commercial-off-the-shelf (COTS) to application (1490)
- Integrate MBMMR into Speakeasy mobile testbed (1000)
- Demonstrate MBMMR user interface and narrowband waveform capabilities (1400)
- Develop conceptual prototypes for integrated communication network control (2290)
- Demonstrate high frequency (HF)/very high frequency (VHF) radio enhancements for digitized battlefield (1968)

Project D257 - Digital Battlefield Communications: The objective of this project is to integrate communications hardware and software capable of providing seamless, multimedia communications for the digitized battlefield, designed to meet emerging requirements for high capacity, on-the-move (OTM) information exchange. Force projection and evolving doctrine are expected to require significantly more communications bandwidth, drastically altered traffic patterns, new services (e.g. imagery), and higher mobility, especially at echelons brigade and below, than is currently supported by today's communications systems. This project will develop and demonstrate a series of products, through an evolutionary process, capable of transitioning into field units to support the future digitized brigade, division and corps. Through an extensive modeling and simulation activity, utilizing distributed interactive simulation (DIS), the project will build on early system performance models begun under the Combined Arms Command and Control (CAC2) program, in order to identify appropriate non-developmental wideband communications systems to supplement the data capacity of existing lower echelon networks. Once data "hot spots" and congestion points are identified in the existing architecture, warfighter demonstrations will be used to demonstrate the warfighter benefit of added capacity at key locations on the digitized battlefield, and to identify and size fieldable deployment packages consisting of wideband digital communications and support devices to supplement existing tactical communications systems. Technology demonstration units of wide-bandwidth digital radios will be required. Laboratory demonstrations and protocol development to permit asynchronous transfer mode (ATM) traffic to interface with tactical radio/satellite equipment will be conducted. A mobile radio access point (RAP) consisting of a high capacity, OTM trunk radio, powerful portable switch (ATM or other) and legacy wide bandwidth digital subscriber networks will be developed and evaluated by troops in the field. The RAP will provide a high bandwidth OTM trunk feed in support of combat net radio, single channel radio access (SCRA), and wideband data subscribers, all communicating OTM. Network planning tools and dynamic internetwork management schemes will be exploited for both pre-battle communications planning and dynamic reconfiguration during deployment. Development of OTM antennas begun in prior years will be extended to provide fieldable, low profile antennas better suited to OTM wideband needs to connect forward mobile elements in split based deployments. Wideband airborne communications relays will be developed and evaluated for warfighter utility in achieving range extension at high data rates. Commercial personal communication systems (PCS) and direct broadcast satellite (DBS) will be evaluated for possible tactical exploitation.

FY 1994 Accomplishments: Program not funded

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FY 1995 Planned Program:

- Demonstrate wideband data communications network to alleviate CAC2 "hotspots" and satisfy high data rate intelligence requirements (3180)
- Develop, link and network models, enhance system performance models and develop trunk radio simulation; evaluate alternative architectures (700)
- Develop digitized battlefield network planning tools (800)
- Demonstrate tactical radio and satellite communications interface to commercial-off-the-shelf (COTS) asynchronous transfer mode (ATM) products (1550)
- Develop OTM ultra high frequency (UHF) SATCOM low profile antenna for Common Ground Station (1205)
- Begin specification definition and design of RAP technology demonstrator (930)
- Begin experimentation with direct broadcast satellite (150)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (183)

FY 1996 Planned Program:

- Begin integration of ATM service into legacy communications network (4200)
- Complete functional definition of RAP (2888)
- Complete COTS testing/requirements definition for high capacity trunk radio (HCTR) (600)
- Complete demonstration of low profile OTM antennas (730)
- Begin experimentation with wideband airborne communications relays and satellite personal communications services (PCS) (596)
- Complete advanced warfighter demonstration with Battle Command Battle Lab, Fort Gordon, GA (1840)

FY 1997 Planned Program:

- Begin modification of COTS non-developmental-item (NDI) hardware for high capacity trunk radio (HCTR) demonstration (2114)
- Demonstrate direct broadcast video for tactical applications (1810)
- Acquire hardware for RAP concept demonstration (1620)
- Demonstrate 45 mega bits per second airborne communications relay package (915)
- Demonstrate super high frequency OTM antenna for RAP (960)
- Support user demonstrations (1070)
- Integrate ATM into legacy communications systems (2650)
- Complete modeling and simulation tools for RAP/HCTR development (1200)

Project D592 - Space Application Technology: The objective of this project is to optimize Army utilization of space. The project involves: (a) space technology demonstrations for evaluating technology feasibility, determining Army utility, and refining technology requirements, and (b) technology development to support Army ground stations utilizing space assets. The project also addresses: defining Army requirements for space platform providers; demonstrating advanced, compact hardware, such as synthetic aperture radar (SAR) processors; and developing algorithms that optimally process space data, i.e., sensor fusion algorithms. Army efforts include: integration of direct downlink weather and terrain data into intelligence preparation of the battlefield (IPB) and integrated meteorological system (IMETS) processes;

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Army-unique applications of global positioning system (GPS) signals; technologies to apply high data rate, extremely high frequency (EHF) communications capabilities to satellite communications (SATCOM) on-the-move; technologies to make multispectral imagery more suitable to tactical applications, space experiments, and data collection and analysis on ionospheric composition to support imaging and communications.

FY 1994 Accomplishments: Program not funded

FY 1995 Planned Program:
- Complete restructuring of the Space Application Technology program and integrate into the overall USASSDC program (191)
- Complete refurbishment of extreme ultraviolet imaging photometer (UVIP) (48)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with Small Business Innovative Research Program Reauthorization Act of 1992 (5)

FY 1996 Planned Program:
- Reduce UVIP data (50)
- Evaluate utility of space for Army and prioritized technologies (100)
- Leverage on-going hyper/multispectral efforts and initiate demonstrations (298)
- Initiate planning for laser communications demonstrations (50)

FY 1997 Planned Program:
- Collect and evaluate hyperspectrual data (298)
- Participate in laser communications demonstration (100)

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	8028	17179	17285	20818
Appropriated Value	8028	16829		
Adjustments to Appropriated Value	-242			
a. SBIR/STTR decrement (-117)				
b. Reprogramming (-125)				
Current President's Budget Submit	7786	16829	16922	20885

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603006A Cmd, Cntrl And Comm Adv Technology

PROJECT: D247

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D247 Tactical C4 Technology Integration	7786	7887	5570	8148	8315	13347	11990	11281	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct laboratory test of all SAS technologies								X								
Develop specifications/documentation for objective COMM systems management and control in support of CAC2												X				
Demonstrate HF/VHF radio enhancements for the digitized battlefield																X
MBMMR ADM narrowband waveform demonstration																X
Begin MBMMR integration into mobile testbed																X

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603006A Cmd, Cntrl And Comm Adv Technology

PROJECT: D257

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D257 Digital Battlefield Communications	0	8698	10854	12339	8954	5573	4996	5098	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete funcuional definition of RAP											X					
Complete demonstration of low profile OTM SATCOM antenna												X				
Demonstrate direct broadcast video for tactical applications															X	

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603006A Cmd, Cntrl And Comm Adv Technology

PROJECT: D592

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D592 Space Applications Technology	0	244	498	398	597	299	450	449	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Integrate Space Application Technology program into USASSDC program								X								
Participate in laser communications demonstrations																X

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603007A Manpower, Personnel And Tng Advanced Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	8093	5100	4826	4635	5456	6482	7598	7680	Continuing	Continuing
A792 Manpower and Personnel	4335	2786	2265	1461	2104	2576	3119	3148	Continuing	Continuing
A793 Training Systems and Education	3758	2314	2561	3174	3352	3906	4479	4532	Continuing	Continuing

A. **Mission Description and Budget Item Justification:** The objective of this program is to demonstrate soldier-oriented technologies to enhance soldier and unit performance. These include: training strategies for simulation-based training; methods that develop the knowledge and skills required for successful battle command on the increasingly digitized battlefield; accurate behavioral models of individual and unit warfighting performance for use in synthetic environments; optimized design of battle command staff groups for improved command and control (C2); and a new selection and assignment technology for better soldier/job matching to maintain warfighting capabilities in a downsized Army. Work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. These projects are dedicated to conducting proof of principal field demonstrations and tests of system-specific technologies to meet specific military needs and are therefore correctly placed in Budget Activity 3. This PE is managed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), Alexandria, VA.

Project A792 - Manpower and Personnel: This project demonstrates soldier-oriented technologies that will lead to improved Army personnel utilization, including enlisted, officers, civilians, and families. A major focus of the project is on the human leader and decision maker in evolving digitized, battle command systems. The research will also demonstrate new methods for identifying high quality male and female enlistees, for assigning them to Military Occupational Specialties (MOS) that maximize total force readiness, and for retaining the most effective performers. It also develops and demonstrates behavioral science-based methods to achieve optimized design of Army decision-making staff organizations. Other efforts will develop innovative, simulation-based methods for career-long leader development, e.g., to ensure that some of today's lieutenants and captains develop adequate knowledge and skills to become tomorrow's division commanders for the digitized battlefield. This program supports the Manpower and Personnel Defense Technology Area. Work on this element is coordinated with the Training and Doctrine Command (TRADOC) Battle Laboratories, and demonstration projects are integrated into the Battle Labs' Advanced Warfighting Experiments.

FY 1994 Accomplishments:

- Constructed guidelines for organizational design with respect to leader span-of-control (258)
- Identified links between peacetime performance and rated combat performance (592)
- Developed MOS restructuring tools; updated procedures for administering selection and classification tests (736)
- Developed a prototype career decision aid for Special Forces (SF) recruits and families (1118)
- Assessed impact of family support measures during Operation Restore Hope (247)

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603007A Manpower, Personnel And Tng Advanced Technology

- Provided evaluation methodology and baseline data for assessing the impact of the evolving Army Tactical Command and Control System (ATCCS) on battle command performance (1384)

FY 1995 Planned Program:

- Prepare comprehensive recommendations for modifications to the selection, classification, reenlistment and promotion systems based on integration of Career Force and cost-effectiveness findings (843)
- Integrate the Battle Command Training Program (BCTP) data base and other performance data into the Combat Training Center's Warrior Information Network for analyses on battle command decision making (1127)
- Develop job structuring guidebooks (130)
- Develop improved selection procedures for Special Operations/Low Intensity Conflict forces (559)
- Develop tools and techniques to examine issues related to National Guard deployment in the Multinational Force of Observers (MFO) peacekeeping mission(68)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (59)

FY 1996 Planned Program:

- Develop improved soldier-job matching procedures by effectively utilizing psychomotor, spatial and temperament measures (180)
- Refine SF selection and assignment tests and procedures (521)
- Provide preliminary findings on determinants of battle command performance and recommendations for decision aid evaluation methodologies to the Battle Command Battle Lab (1386)
- Develop methods for improving occupational analysis efficiency and accuracy (178)

FY 1997 Planned Program:

- Provide guidelines for harnessing available and projected information technologies to support effective battle command on the future digitized battlefield (366)
- Identify organizational structures which take advantage of developing information technologies to support battle command (287)
- Provide techniques for developing and training tactical decision skills (808)

Project A793 - Training Systems and Education: The objective of this project is to demonstrate empirically-based training strategies, i.e., models for guiding the selection and application of expensive training methods and resources. The focus of this research is how to best use distributed interactive simulation (DIS) training environments. This program is predicated on research showing that the effectiveness of training aids, devices, simulations, and simulators (TADSS) is largely a function of how they are used in training, including the adequacy of performance measurement techniques and performance feedback methods. Training strategies will be developed to integrate all three types of simulation (live, virtual and constructive) into a seamless training environment that will enhance training quality, relevancy and efficiency for warfighting missions and for operations other than war (OOTW). In future years, the project will develop training strategies for the increasingly digitized battlefield. This

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research supports the TRADOC Battle Labs and will utilize emerging Battlefield Distributed Simulation-Developmental (BDS-D) capabilities. This program supports the Training Systems Defense Technology Area.

FY 1994 Accomplishments:
- Upgraded Unit Performance Assessment System (UPAS) was demonstrated and transferred to the Simulation, Training and Instrumentation Command (STRICOM) and TRADOC (470)
- Developed prototype computer-based battalion staff training program (770)
- Developed a device-based tank gunnery training strategy for Reserve Components (RC) units (300)
- Conducted a detailed training requirements analysis of the most critical combat functions (CCF) for armored battalion task forces (931)
- Evaluated the training effectiveness of low-cost, aviation part-task training devices (680)
- Developed prototype simulation-based training programs for National Guard Armor units (607)

FY 1995 Planned Program:
- Develop and test front end analysis methodology for determining critical peacekeeping and OOTW training requirements (561)
- Develop prototype automated training analysis and feedback system for generating after action reviews (AARs) for DIS-based training (360)
- Develop a training strategy and prototype training program for the Close Combat Tactical Trainer (CCTT) (599)
- Develop a methodology for designing combined arms training strategies that are compatible with Battalion Level Training Models (291)
- Evaluate effectiveness of intelligent flight trainer for training initial entry rotary wing pilots (455)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (48)

FY 1996 Planned Program:
- Develop TADSS gunnery effectiveness database for RC units (230)
- Develop prototype armor maneuver training strategies (563)
- Produce training developer guidance for generating realistic tactical scenarios for CCTT (537)
- Develop OOTW mission performance measurement methodology (641)
- Design a preliminary aviation training strategy with an emphasis on low-cost, part-task simulators and training devices (590)

FY 1997 Planned Program:
- Develop and test brigade-level training strategies and performance assessment methodologies (634)
- Develop and evaluate Light Forces OOTW training strategies (476)
- Develop prototype DIS-based training modules for Special Operations Forces mission planning (603)
- Develop prototype training programs for battalion echelon contingency operations and OOTW rules of engagement (480)

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603007A Manpower, Personnel And Tng Advanced Technology

- Design and test prototype aviation training strategies with alternative mixes of TADSS and live training (981)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	8064	5698	6038	6565
Appropriated Value	8064	5100		
Adjustments to Appropriated Value	+29			
a. SBIR/STTR decrement (-125)				
b. Reprogramming (+154)				
Current President's Budget Submit	8093	5100	4826	4635

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603007A Manpower, Personnel And Tng Advanced Technology

PROJECT: A792

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A792 Manpower and Personnel	4335	2786	2265	1461	2104	2576	3119	3148	Continuing	Continuing

C. Other Program Funding Summary: N/A

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Construct guidelines for organizational design with respect to leader span-of-control				X*												
Develop a prototype career decision aid for Special Forces recruits and families				X*												
Develop tools to examine National Guard deployment in the Multinational Force of Observers peacekeeping Mission								X								
Develop improved soldier-job matching procedures												X				
Provide techniques for developing and training tactical decision skills																X

(Asterisk denotes completed action)

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603007A Manpower, Personnel And Tng Advanced Technology

PROJECT: A793

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
A793 Training Systems and Education	3758	2314	2561	3174	3352	3906	4479	4532	Continuing	Continuing

C. Other Program Funding Summary: N/A

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Develop a device-based tank gunnery training strategy for RC units				X*												
Develop a training strategy and prototype training program for CCTT								X								
Develop prototype automated training analysis and feedback system for generating AARs for DIS-based training								X								
Develop OOTW mission performance measurement methodology												X				
Design and test prototype aviati training strategies with alternative mixes of TADSS and live training																X

(Asterisk denotes completed action)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603105A Military HIV Research		PROJECT DH29

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DH29 Medical Protection Against HIV	32892	30345	2946	3006	3151	3329	0	0	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element supports research to provide concept exploration of candidate prevention and treatment strategies such as vaccines, drugs and behavioral interventions, to include safety and efficacy in model systems to prepare and conduct clinical studies. This program is managed primarily by the US Army Medical Research and Materiel Command. This program is dedicated to conducting proof of principal demonstrations and tests of specific technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

Project DH29- Military HIV Research: This program element funds Congressionally directed Acquired Immune Deficiency Syndrome (AIDS) research to control the infection in military environments, to protect the military blood supply and to protect military personnel from unusual risks associated with infection. AIDS research is focused on the following thrust areas: diagnosis; natural history; epidemiology; vaccine development; and drug therapy. Efforts are directed to answer militarily unique questions affecting manning, mobilization and deployment. The major contractor is Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, MD.

FY 1994 Accomplishments:
- Evaluated candidate prophylactic and immunotherapeutic vaccines (6114)
- Designed methods for rapid diagnosis and quantification of Human Immunodeficiency Virus (HIV). (2361)
- Evaluated unique HIV peptides, carriers and adjuvants for inclusion in future vaccines. (4312)
- Assessed behavior modifications to control the spread of HIV infection in response to intervention methods. (5503)
- Evaluated combination therapy to prevent/treat drug resistant HIV strains and opportunistic infections (3457)
- Evaluated results of Phase II GP 160 vaccine trial; collected and characterized HIV strains worldwide. (5405)
- Developed appropriate models to conduct studies of pathogenesis and evaluated new approaches to treatment. (5740)

FY 1995 Planned Program:
- Continue Phase II clinical trial of therapeutic vaccine. (4699)
- Prepare field site for prophylactic vaccine trial in Thailand. (2448)
- Collect, characterize, and evaluate global HIV strains. (6266)
- Evaluate carriers, adjuvants, and antigens as candidate HIV vaccines. (4699)
- Evaluate methods for rapid diagnosis. (1615)
- Evaluate methods to quantify HIV virus burden and immune response to therapeutic and prophylactic vaccines in human volunteers. (3240)
- Develop technical data package to transition prophylactic vaccine to advanced development. (1150)

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BUDGET ACTIVITY: 3 - Advanced Development	PE NUMBER AND TITLE: 0603105A Military HIV Research / PROJECT: DH29

- Develop technical data guide policy on unit level behavior modification. (2164)
- Evaluate combination methods for vaccine/drug therapy of HIV infection. (3427)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (637)

FY 1996 Planned Program:

- Prepare field site for clinical trials of candidate vaccine. (1974)
- Evaluate safety and immunogenicity phase I and phase II of candidate vaccine. (972)

FY 1997 Planned Program:

- Continue field site preparation for candidate vaccine clinical trials. (1999)
- Complete safety and immunogenicity phase I and phase II of candidate vaccines. (1007)

B. Program Change Summary:

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	33410	3185	2961	3021
Appropriated Value	33410	30345		
Adjustments to Appropriated Value	-518			
SBIR/STTR (-518)				
Current President's Budget Submit	32892	30345	2946	3006

C. Other Program Funding Summary: Not Applicable

D. Schedule Profile: The efforts in this project are non-system specific and represent continuing advanced development research in the area of medical technology, therefore no milestones or events are provided.

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	20552	40198	39824	39998	29002	19907	19984	19953	Continuing	Continuing
D177 JT ALS PS DEMO	10797	31226	34104	26286	20669	15926	19984	19953	Continuing	Continuing
D182 Tractor Hole	9286	8059	0	0	0	0	0	0	0	17345
D189 Tractor Hike	469	913	0	0	0	0	0	0	0	14108
D546 STARLOS	0	0	5720	13712	8333	3981	0	0	0	31746

A. Mission Description and Budget Item Justification This program provides for the integration of high-payoff technologies and new technical, architectural and operational concepts, along with existing and emerging systems to demonstrate enhanced precision strike and counterfire capabilities for ground targets at deep and extended ranges. The objective is to address the operational need to locate, identify, and kill high-value, time-critical targets and to assess damage within tactically meaningful timelines. To address this objective, the program will conduct a series of building block demonstrations to identify technical and operational barriers in an adverse weather, day/night, end-to-end sensor-to-shooter precision strike capability and to demonstrate and experiment with candidate solutions to these barriers. This program works closely with the Army user community, primarily with the U.S. Army Training and Doctrine Command (TRADOC) Depth and Simultaneous Attack Battle Lab at Fort Sill, OK and Battle Command Battle Lab at Fort Huachuca, AZ, to ensure realistic operational context and to provide close interaction between the developer and the customer for more efficient product development. Program goals are to reduce timelines from hours to minutes as well as to achieve quantifiable improvements in target location and identification, weapons systems responsiveness and kill capability, and accurate damage assessment through such techniques as near-real-time sensor cueing, near-real-time data dissemination, seamless sensor-to-shooter node communication, dynamic retargeting, improved weapons system accuracy and precision guided munitions. The demonstrations and experiments will use a combination of real system operation, live testing, distributed interactive simulation (DIS), modeling, and pre-recorded data inputs coordinated through an Integration and Evaluation Center (IEC) to run end-to-end scenarios and assess results. The work is closely coordinated with the combat development community and appropriate materiel developers to conduct field demonstrations and experiments to assess specific technologies for military needs and is therefore placed in Budget Activity 3. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan, the Army Modernization Plan and Project Reliance.

Project D177 - Joint Air/Land/Sea Precision Strike Demonstration: This project conducts a series of building block demonstrations to identify barriers to an advanced precision strike capability and to assess candidate solutions to these barriers. In FY94, a surface-to-surface demonstration was conducted in conjunction with the program manager for the Army Tactical Missile System (ATACMS) to demonstrate deep targeting and deep fires coordination in support of a live firing of an extended range ATACMS missile, and planning for a demonstration to counter the North Korean 240mm Multiple Rocket Launcher (MRL) threat was completed. For FY95, execution of this demonstration, which has been approved as an OSD Advanced Concepts Technology Demonstration (ACTD) titled Precision/Rapid Counter-MRL, was initiated.

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In late FY95 a CONUS demonstration of the ACTD will be conducted as a first step towards conducting the objective ACTD demonstration in Korea in FY96. The ACTD will combine live inputs and simulations to address the surveillance/reconnaissance, target acquisition, strike planning, weapons delivery and combat assessment functions of precision strike to provide the Commander-in-Chief (CINC) U. S. Forces Korea/Combined Forces Command (USFK/CFC) with a significantly improved capability to defeat the 240mm MRL threat. In addition, a set of leave-behind capabilities, consisting of the Korean Combined Operations Intelligence Center (KCOIC) Connectivity, a second generation (2nd GEN) forward looking infrared sensor with a line scanner (FLIR/LS) designed for application on a UAV, sensor to shooter systems automation tools for a tactical operations center (TAC), and a modified Dual Purpose Improved Conventional Munition (DPICM) for the Multiple Rocket Launch System (MLRS) will be delivered to the CINC USFK/CFC during FY96/97, with two years of follow-on technical support, to immediately improve the CINC's warfighting capability against this threat. For FY97, execution of the building block demonstrations that follow the ACTD will be initiated. The program is managed by the Director, Joint Precision Strike Demonstration (JPSD), Office of Program Executive Officer - Intelligence and Electronic Warfare (PEO-IEW), Falls Church, VA. The prime contractor is Raytheon, Bedford, MA.

FY 1994 Accomplishments:
- Prepared final report on FY93 Unmanned Aerial Vehicle (UAV) Demonstration (50)
- Began operation of the JPSD Integration and Evaluation Center (3472)
- Conducted concept development, DIS, CINC and Battle Lab Support (2625)
- Conducted the FY94 Surface to Surface Demonstration (4250)
- Participated in Advanced Research Projects Agency (ARPA) War Breaker Program (250)
- Participated in TRADOC's Integrated Battlefield Architecture Study (150)

FY 1995 Planned Program:
- Prepare FY94 Final Demonstration Report (90)
- Provide concept development, DIS, CINC and Battle Lab Support (4850)
- Conduct systems engineering/demonstration planning (3800)
- Prepare IEC for FY95 Demonstration (5800)
- Conduct 2nd GEN FLIR/LS Technology Demonstration (7300)
- Conduct Rapid/Counter-MRL ACTD (CONUS Demonstration) (8480)
- Participate in ARPA War Breaker Program (250)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (656)

FY 1996 Planned Program:
- Conduct systems engineering/demonstration planning (5067)
- Provide concept development, DIS, CINC and Battle Lab Support (1280)

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- Install demonstration systems and conduct Rapid/Counter-MRL ACTD demo in Korea (8286)
- Prepare IEC for FY96 Demonstration (1980)
- Fabricate Modified DPICM Munition (10000)
- Fabricate 2nd GEN FLIR/LS for installation in UAV (6600)
- Complete analysis and prepare final report for FY95 CONUS demonstration (380)
- Participate in ARPA War Breaker program (511)

FY 1997 Planned Program:

- Provide concept development, DIS, CINC and Battle Lab Support (2390)
- Provide technical support of leave-behind capability from FY96 ACTD (5000)
- Fabricate and deliver Modified DPICM/MLRS leave-behind (6000)
- Fabricate and deliver 2nd GEN FLIR/LS leave-behind (2300)
- Participate in ARPA War Breaker program (540)
- Conduct systems engineering/demonstration planning (3690)
- Conduct Survivable Armed Reconnaissance on the Digital Battlefield Demonstration (6366)

Project D182 Tractor Hole: (Classified Program)

Project D189 Tractor Hike: (Classified Program)

Project D546 STARLOS: This program demonstrates the feasibility of locating and identifying high value targets from an Army designated aerial platform and transitioning this technology to industry. The main focus of the program is on Short Range Ballistic Missiles (SRBM), surface-to-air missile launchers and rocket launchers. The targets are located and identified by means of a high resolution Synthetic Aperture Radar (SAR) with a real-time Automatic Target Recognition (ATR) System. Spin-off technological advancements have dictated a minor focus on Moving Target Indicator (MTI) radar enhancement and economical Automatic Target Cueing (ATC) of other than high value targets and advanced SAR/MTI performance capabilities for light weight air vehicles. The program has become a major component of the Joint Precision Strike Program and was the impetus for the development by industry of a high resolution SAR for onboard the Joint Chiefs of Staff (JCS) Medium Altitude Endurance (MAE) class of Unmanned Aerial Vehicle (UAV). This program is an element of the Precision/Rapid Counter-MRL ACTD and the MAE UAV ACTD. This program is managed by PEO-IEW, Program Manager- Tactical Endurance Synthetic Aperture Radar (PM-TESAR), with matrix support from Army Research Laboratory, Adelphi, MD and CECOM RDEC, Fort Monmouth, NJ. Work is performed by the Department of Energy-sponsored Sandia National Laboratory, Albuquerque, NM.

FY 1994 Accomplishments: Project not funded

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FY 1995 Planned Program: Project not funded

FY 1996 Planned Program:

- Continue SAR ATR algorithm development for increasingly difficult cover, camouflage and deception (CC&D) scenarios (1200)
- Demonstrate real time SAR ATR of high value targets with the SAR payload from JCS MAE UAV ACTD (1070)
- Participate in JPSD Precision/Rapid Counter MRL ACTD, Roving Sands Advanced Warfighting Experiment (AWE) and user demonstrations (750)
- Continue study/evaluation of multi-sensor ATC/ATR algorithms and industry/government SAR ATR algorithm capabilities (500)
- Continue Cooperative Research and Development Agreement involvement and prepare request for proposal (RFP) and award contract for ATR/ATC demonstration/prototype capability (1500)
- Under common ATR architecture initiative, form partnership with ARPA to enhance Operational Target Recognition/Cueing Capabilities (200)
- Demonstrate on-board, real-time, operationally robust, SAR ATC for additional targets with a multi-sensor airborne test bed (500)

FY1997 Planned Program:

- Continue SAR ATR algorithm development for increasingly difficult CC&D scenarios (2700)
- Participate in JPSD Low Intensity Conflict (LIC) Demonstration (600)
- Complete integration of MAE UAV/STARLOS for total system capabilities (2108)
- Demonstrate platform (UAV) Integration (operational/contingency use system) (1700)
- Complete next generation of ATR/ATC processing hardware with focus on weight, size, targeting requirements (4854)
- Demonstrate SAR commercially based ATC/ATR capabilities with multi sensors on test bed (1750)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	20875	41834	37112	36540
Appropriated Value	20875	40198		
Adjustments to Appropriated Value	-323			
SBIR/STTR decrement (-323)				
Current President's Budget Submit	20552	40198	39824	39998

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PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology

PROJECT: D177

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D177 JT ALS PS DEMO	10797	31226	34104	26286	20669	15926	19984	19953	Continuing	Continuing

C. **Other Program Funding Summary:** N/A

D. **Schedule Profile:**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
FY94 DEMO ATACMS Firing				X*	X*											
FY94 DEMO				X*	X*											
FY94 DEMO VIP Session					X*											
FY95 CONUS DEMO								X								
FY96 OCONUS DEMO												X				
Support for USFK Leave Behinds													X	X	X	X
FY97 LIC DEMO															X	

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BUDGET ACTIVITY: 3 - Advanced Development	PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology		PROJECT: D182

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D182 Tractor Hole	9286	8059	0	0	0	0	0	0	0	17345

C. **Other Program Funding Summary:** Classified Program

D. **Schedule Profile:** Classified Program

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology

PROJECT: D189

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D189 Tractor Hike	469	913	0	0	0	0	0	0	0	14108

C. **Other Program Funding Summary:** Classified Program

D. **Schedule Profile:** Classified Program

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603238A Air Defense/Precision Strike Technology

PROJECT: D546

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D546 STARLOS	0	0	5720	13712	8333	3981	0	0	0	31746

C. Other Program Funding Summary: N/A

D. Schedule Profile:

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
STARLOS/MAE UAV Interoperability Demos									X		X					
Participate in JPDS Precision/Rapid Counter MRL ACTD (in Korea)												X				
Participate in JPSD LIC Demo															X	
MAE UAV/STARLOS Integration Demo																X

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603270A EW Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	32048	6743	4022	6489	9084	15199	18985	19954	Continuing	Continuing
DK15 Advanced Communications Electronics Countermeasures Demonstration	4142	2937	2963	3500	4477	7235	9992	9977	Continuing	Continuing
DK16 Non-Communications Electronic Countermeasures Technology Demonstration	5243	3806	1059	2989	4607	7964	8993	9977	Continuing	Continuing
DK18 STINGRAY	22663	0	0	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element provides the Science and Technology funding for three projects which support current and future Electronic Warfare (EW) systems. The Advanced Communications Electronics Countermeasures Demonstration (DK15) provides technology demonstrations in communications countermeasures (CM) and information collection and reporting for transition to Army Intelligence and Electronic Warfare (IEW) systems through the Block Improvement process. The effective use of specific components, software and hardware for multiple applications will enable the Army to collect intelligence from modern modulation threat electronic systems in order to disrupt their operation, denying the enemy use of their Command, Control and Communication (C3) assets. This project also supports demonstrations of automatic fusion of intelligence data from multiple sources. Non-Communications Electronic Countermeasures Technology Demonstration (DK16) demonstrates the feasibility and effectiveness of non-communications electronic warfare hardware and software countermeasures and Electronic Support/Electronic Intelligence (ES/ELINT) for self protection from radar, electro-optical, and infrared guided anti-aircraft artillery, surface-to-air missiles, artillery, and top attack weapons, and provides precise targeting information on non-communications emitters. Area protection technology from radar threats is also developed. Work in these projects will lead to technology applications which will significantly contribute to winning the battlefield information war by controlling the electromagnetic spectrum. Work in this program element (PE) supports the Radar Deception and Jamming (RDJ) and Rotorcraft Pilot's Associate (RPA) technology demonstrations, and provides component technology for the Hit Avoidance technology demonstration. Project DK18 funds STINGRAY, which is an Electro-Optical Countermeasure (EOCM) system mounted on a Bradley Fighting Vehicle; this project is completed in FY1994. Work in this program element adheres to Tri-Service Reliance Agreements on Electronic Warfare with oversight provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with efforts in PE 0602270A (Electronic Warfare Technology), and various Navy and Air Force program elements in accordance with the on-going Reliance joint planning process. Navy developments are conducted in PEs 060455N (Surface Electronic Warfare), 0204575N (Electronic Warfare Support), and 0604573N (Shipboard Electronic Warfare Improvements). Air Force developments are conducted in PEs 0604738F (Protective Systems), 0604793F (Tactical Protective Systems) and 0604710F (Reconnaissance Electronics Warfare Systems). Coordination is effected between the Services and ARPA to eliminate duplication of effort and ensure the interchange of technical data. This program is managed primarily by Communications-Electronics Command Research, Development and Engineering Center (CERDEC). It is dedicated to conducting field demonstrations and tests of technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

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Project DK15 - Advanced Communications Electronics Countermeasures Demonstration: This program demonstrates communication countermeasures technology for the Army to use to exploit, corrupt or destroy an adversary's information system while preserving the integrity of one's own systems during critical periods of tactical transmission. It emphasizes specific components, hardware and software necessary to perform technology demonstrations which will lead to providing flexible systems with the capability of disrupting modern modulations signals which support high mobility forces. This project also demonstrates the technology products that enable, enhance and protect the commander's decision and execution cycle while influencing an opponent's. The fusing of multiple intelligence data inputs with one output will allow the commander to quickly assess the battlefield situation.

FY 1994 Accomplishments:

- Demonstrated capability to simultaneously jam and receive threat signals for upgrades to IEW Common Sensor (IEWCS) and Unmanned Aerial Vehicles (1825)
- Demonstrated and tested evolutionary software to significantly upgrade enhanced maps, smart databases, modules and intelligent networks (815)
- Integrated signal processing, control equipment and software techniques to demonstrate capability to identify and jam digital radio signals (600)
- Completed testing of sensor asset management algorithms for transition to IEWCS and All Source Analysis System (ASAS) (902)

FY 1995 Planned Program:

- Continue integration of signal processing, control equipment and software techniques to demonstrate capability to identify and jam digital radio signals (1075)
- Initiate integration of exploitation strategies for type 1 mobile cellular radio signals for demonstration purposes (1250)
- Complete demonstration and testing of fusion of sensor inputs for battlefield damage assessment, targeting and situation awareness and sensor asset management for transition to Common Ground Station (CGS), IEWCS, and ASAS (350)
- Demonstrate the tools and techniques to effectively task and receive reports from modern multi-intelligence sensor platforms. Focus is on the ASAS/WARLORD and CGS interface (200)
- Funds will be reprogrammed for SBIR/STTR Programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (62)

FY 1996 Planned Program:

- Complete demonstration and testing of exploitation strategies for type 1 mobile cellular radio signals. Transition results to IEWCS (380)
- Complete demonstration and testing of signal processing, control equipment and software techniques to demonstrate capability to identify and jam digital radio signals (1283)
- Initiate integration of exploitation strategies for type 2 mobile cellular radio signals for demonstration purposes (200)
- Complete demonstrations of Signals Intelligence (SIGINT) Asset Management and Automated Map Based Intelligence Sensor System (AMBISS). Transition to IEWCS and ASAS (550)
- Initiate IEW synchronization demonstration which utilizes techniques developed in PE 0602270A/A906 for asset management, terrain management and overlay reasoning (225)
- Integrate SIGINT/Moving Target Indicator (MTI) templating, tracking, cross-queuing and situation display techniques for demonstration and testing and consolidate AMBISS, SIGINT/MTI and battlefield dynamics for Battlefield Visualization Demonstration (125)

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- Demonstrate the tools and techniques to effectively task and receive reports from modern multi-intelligence sensor platforms. Focus is on the ASAS/WARLORD and IEWCS interface (200)

FY 1997 Planned
- Demonstrate utilization of techniques to exploit type 2 mobile cellular radio signals (620)
- Integrate wideband receiver & developments from joint receiver programs for demonstration of receivers used in the exploitation of modern communications signals (730)
- Integrate antenna developments and results from platform antenna analysis for demonstration of an optimum antenna for IEW systems (350)
- Complete IEW synchronization demonstration and transition to ASAS (500)
- Continue SIGINT/MTI demonstration (500)
- Continue consolidation and testing of IEW Battlefield Visualization techniques for demonstration (500)
- Continue demonstration of the tools and techniques to effectively task and receive reports from modern multi-INT sensor platforms. Focus is on the ASAS/WARLORD and IEWCS interface (300)

Project DK16 - Non-Communication Electronics Countermeasures Technology Demonstrations: This program demonstrates the feasibility and effectiveness of non-communication electronic warfare hardware and software CM technology for self protection against radar, optical, electro-optical and infrared threats. It provides aircraft threat warning technology with the Radar Deception and Jamming (RDJ) advanced technology demonstration (ATD). It also provides supporting components for the Hit Avoidance (ground vehicle top attack protection) ATD and IR jammers for helicopter protection.

FY 1994 Accomplishments:
- Evaluate and assess advanced aviation sensor protection technologies to apply to ground vehicles utilizing Horizontal Technology Integration (HTI) concepts to insure commonality across the force structure (2743)
- Complete fabrication of RDJ Sensors (2250)
- Conduct RDJ ground and simulator tests (250)

FY 1995 Planned Program:
- Procure applicable sensors and integrate to ground testbed in preparation for field fighting demonstrations with the Battle Lab in FY96 (2257)
- Conduct RDJ Flight Tests (1300)
- Transition RDJ to Program Manager (PM)-Airborne Electronic Combat (AEC) programs (300)
- Funds will be reprogrammed for SBIR/STTR Programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (78)

FY 1996 Planned Program:
- Develop algorithms for passive missile warning (297)

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- Deliver and integrate ground vehicle top attack missile warning (462)
- Deliver top attack warning subsystem to Hit Avoidance ATD (389)

FY 1997 Planned Program:
- Test and integrate electronic countermeasure (ECM) techniques from PE 0602270A, project A442 (800)
- Integrate high power microwave and laser with anti-tank infrared countermeasure (ATIRCM) (1800)
- Begin modifying multi-spectral CM test aircraft (400)

Project DK18 - STINGRAY: The STINGRAY Combat Protection System (CPS) will provide increased survivability along with added time to engage the threat with conventional armament systems. The STINGRAY CPS is an Electro-Optical Countermeasure (EOCM) system for area protection in combat. The system is being delivered on Bradley Fighting Vehicle System (BFVS) for user testing and evaluation but 2 systems will be available for contingency operations. This system will provide protection from enemy optical and electro-optical (OEO) target acquisition and fire control systems by automatically detecting threatening OEO systems, and will prompt countermeasure response which would apply in-band laser energy. This CM will degrade the enemy's ability to acquire and target friendly forces in the area being protected. In addition, STINGRAY will provide unique target acquisition, tracking and hand-off capability for the host vehicle.

FY 1994 Accomplishments:
- Execute Phase II & III Simulation Program (823)
- Complete contract technology development effort and obtain test equipment (16799)
- Conduct government technical testing (2376)
- Conduct government operational testing and hand-off to user (2465)
- Conduct program exit procedures (200)

FY 1995 Planned Program: Program Not Funded

FY 1996 Planned Program: Program Not Funded

FY 1997 Planned Program: Program Not Funded

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B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	32553	6967	4040	6098
Appropriated Value	32553	6743		
Adjustments to Appropriated Value	-505			
a. SBIR/STTR decrement (-505)				
Current President's Budget	32048	6743	4022	6489

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PE NUMBER AND TITLE: 0603270A EW Technology

PROJECT: DK15

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DK15 Advanced Communications Electronics Countermeasures Demonstration	4142	2937	2963	3500	4477	7235	9992	9977	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Test sensor asset management algorithms for transition to IEWCS and ASAS				X*												
Demonstrate sensor input fusion for transition to Common Ground Station (CGS), IEWCS, and ASAS								X								
Demonstrate exploitation strategies for type 1 mobile cellular radio signals											X					
Demonstrate IEW synchronization and transition to ASAS																X

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PE NUMBER AND TITLE: 0603270A EW Technology

PROJECT: DK16

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DK16 Non-Communications Electronic Countermeasures Technology Demonstration	5243	3806	1059	2989	4607	7964	8993	9977	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct RDJ flight tests and transition RDJ to PM-AEC								X								
Deliver top attack warning subsystem to Hit Avoidance ATD												X				

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COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DK18 STINGRAY	22663	0	0	0	0	0	0	0	0	0

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct Phase II & III Simulations			X*													
Conduct Technical Testing			X*													
Conduct Operational Testing				X*												
Close Out Program				X*												

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BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

COST (*In Thousands*)		FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	45053	77212	123913	112429	107762	80508	65754	61561	Continuing	Continuing
D206	Missile Simulation	3765	3825	3150	4044	4986	5547	6600	6691	Continuing	Continuing
D263	The Army Combined Arms Weapon System (TACAWS) Technology Demonstration(s)	17565	14376	19137	9249	1032	5008	18985	22946	Continuing	Continuing
D380	Multi-Platform Launcher	0	1365	3779	3779	8954	11942	16987	19953	Continuing	Continuing
D387	Multi-Purpose Individual Munition	0	5601	4575	3892	0	0	0	0	0	14068
D401	Insensitive Munitions for Missile Propulsion	4519	0	0	0	0	0	0	0	0	17556
D486	Rapid Force Projection Simulation	7475	7234	5945	8083	8689	5308	0	0	0	43359
D493	Rapid Force Projection Demonstration	1408	4064	17967	24817	30783	28928	14189	11971	Continuing	Continuing
D496	Enhanced Fiber Optic Guided Missile (EFOG-M) Demonstration	10321	40747	69360	58565	53318	23775	8993	0	0	265291

A. Mission Description and Budget Item Justification: This program element demonstrates advanced missile technologies to enhance U. S. Army force structure. Major objectives for investigation are system deployability, lethality, survivability, flexibility and affordability. Work is conducted through system simulation/virtual prototyping, system design, hardware development and test, and demonstration in laboratory and operational scenarios. This program element provides for the demonstration of advanced tactical missiles and systems using missiles and includes real-time hardware-in-the-loop simulation technology, multi-role fire-and-forget seeker technologies capable of locating targets in clutter, lightweight launcher improvements and enhanced rocket accuracy, advanced technologies for missile guidance, missile warheads, and smart, stealthy, smokeless missile propulsion. This program element also provides full integration of battlefield technologies including hunters (forward sensors) and killers (weapons) integrated through advanced command and control. These components will demonstrate a system of systems approach through the umbrella of the Rapid Force Projection Initiative (RFPI) Early Entry Program, which will provide enhanced survivability and lethality for light, early-entry U.S. forces in a contingency role. The RFPI program supports one of the top five future joint warfighting capabilities, to promptly engage regional forces in decisive combat on a global basis, and is supported by the Dismounted Battlespace Battle Lab (DBBL), with participation from the 18th Airborne Corps. This program element now contains the only Army demonstration of fiber optic guided missile technology and will support the Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD), a top OSD priority program. Multiple EFOG-M fire units and missiles (with a limited manrating) will participate in RFPI field tests. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This program element supports the U.S.

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Army Training and Doctrine Command (TRADOC) Battle Labs. Work in this Program Element is related to and fully coordinated with efforts in PE0601104A, PE0602303A, PE 0603238A, and PE 0603363F in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments. These projects include proof of principle field demonstrations and tests of technologies to meet specific military needs and are therefore properly placed in Budget Activity 3.

Project D206 - Missile Simulation: This project supports three separate, but related tasks: (a) development, expansion, and improvement of hardware-in-the-loop (HWIL) simulation capabilities applicable to the evaluation of tactical missiles guided by signals in radio frequency (RF), millimeter wave (MMW), electro-optical (EO), and infrared (IR) electromagnetic spectral regions. Evaluation by means of HWIL provides cost effective support to missile development throughout weapon system life cycles and permits a reduction in the number of flight tests actually performed. HWIL simulation employs actual missile guidance and control hardware operating in real-time in a non-destructive laboratory environment; (b) Distributed Interactive Simulation (DIS) via a node to the Advanced Research Projects Agency (ARPA) Defense Simulation Internet; and (c) Battlefield Environment Weapon System Simulation (BEWSS), which provides an all-analytical simulation of a weapon system engaging multiple targets in a simulated battlefield environment, including the effects of natural and battle-caused obscurants and disturbances. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command (MICOM), Redstone Arsenal, AL. Major contractors are Boeing Defense and Space Group, Seattle, WA; and Nichols Research Corporation, Huntsville, AL.

FY 1994 Accomplishments:

- Completed development of the multi-element digital signal processor for HWIL signal environment simulation; demonstrated a bandwidth of 800 kilohertz (200)
- Tested and placed Millimeter Simulation System 2 (MSS2) into operation for support of Patriot Advanced Capability - Block 3 (PAC-3) (1300)
- Integrated the low cost host computer into the Imaging Infrared HWIL Simulation System (IIRSS) which is supporting Brilliant Antitank (BAT) and Javelin HWIL simulations (300)
- Integrated the next generation electro-optical target and background scene generator into the IIRSS for Javelin (650)
- Demonstrated multi-channel laser diode infrared target scene projector with 8 channels (391)
- Connected the MICOM Distributed Interactive Simulation (DIS) node to the ARPA Defense Simulation Internet (DSI) (300)
- Established virtual prototyping and reconfigurable simulator capability within the MICOM DIS center (424)
- Incorporated the MMW obscurant countermeasure models into BEWSS (200)

FY 1995 Planned Program:

- Improve signal generation capability in Millimeter Simulation System 1 to support Longbow Engineering and Manufacturing Development (EMD) (612)
- Upgrade radio frequency environment and background generation computers and software in the Radio Frequency Simulation System to support electronic countermeasures evaluation and foreign materiel exploitation (735)
- Expand low cost host processor for Simstar hybrid computers to support Stinger and Army Tactical Missile System (ATACMS) simulation (633)
- Develop improvements to the real-time scene generator for target and background scene presentation for electro-optically guided missiles (BAT, JAVELIN) and The Army Combined Arms Weapon System (TACAWS) (275)

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- Design and develop improvements to laser-diode based infrared scene projector for applications to BAT, Javelin, and Theater High Altitude Air Defense (THAAD) (558)
- Support DIS implementation for BAT, ATACMS, and Multiple Launch Rocket System (MLRS) (193)
- Initiate warfighting simulation experiments with Battle Labs (300)
- Integrate BEWSS capabilities into DIS (200)
- Evaluate further improvements to obscurant modeling and validation for BEWSS (250)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (69)

FY 1996 Planned Program:

- Upgrade and improve RF hardware-in-the-loop simulation capabilities with new hardware to support Longbow, pre-planned product improvement (P^3I) BAT and Patriot PAC-3 development (1164)
- Develop new hardware-in-the-loop simulation capabilities to support customers in other services and friendly foreign governments with electronic counter measure evaluations (457)
- Continue development of an infrared scene projector for application to Javelin, BAT and TACAWS development (631)
- Improve scene generation capability across all simulation wavebands to support missiles guided by electro-optical and millimeter wave seekers (425)
- Expand basic Distributed Interactive Simulation capability at the MICOM Defense Simulation Internet node and local network supporting Bradley Stinger Fighting Vehicle (BSFV), Line-of-Sight Anti-Tank (LOSAT), Javelin, Army Tactical Missile System / BAT (ATACMS/B) and MLRS (315)
- Develop improvements to the BEWSS suite of simulation models (158)

FY 1997 Planned Program:

- Convert and validate RF hardware-in-loop simulation software for Longbow, P^3I BAT, and Patriot PAC-3 support (605)
- Demonstrate improved hardware-in-the-loop simulation capabilities to support developer of tactical missiles (809)
- Demonstrate IR scene projector capability for application to Javelin, BAT and TACAWS development (607)
- Continue scene generation capability improvement to support development of electro-optically and radar guided missiles (607)
- Demonstrate distributed interactive simulation capabilities in operational exercise (809)
- Continue improvements to the BEWSS Test Bed simulation models (607)

D263 - The Army Combined Arms Weapon System (TACAWS) Technology Demonstration(s): This project provides for the demonstration of advanced tactical missile technologies including seekers, propulsion, airframes, warheads, and guidance and control. The project will demonstrate lightweight multi-role missile technology in support of ground-to-ground, ground-to-air, air-to-air and air-to-ground missions. Combined, flexible capability allows one system or variants of one system to replace many, realizing potential extensive savings in development costs, logistics, and training. Particular attention will be given to the development of infrared (IR) seeker technology capable of long range lock-on and defeat of helicopters buried in cluttered backgrounds, variable thrust smart propulsion allowing system range extension and thus standoff and high survivability, and the innovative use of RF data links for identification friend or foe, and the attack of targets masked from the launch platform. The

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missile system demonstration includes the integration of guidance, control, propulsion, airframe and warhead technologies capable of performing in high clutter/obscurants, adverse weather environments and under countermeasure conditions. Missile control and guidance system technology will explore capabilities such as lock-on before/lock-on after launch, fire and forget, command guidance, imaging infrared signal and image processing, and wide band secure data links. Multi-mission seeker (M^2S) technology transitioned from the Balanced Technology Initiative program will be evaluated. Demonstrated missile system performance (i.e., weight, range, kill ratio, speed, lethality) will be optimized to exceed current baseline parameters of ground-to-ground tube launched optically guided (TOW) , ground-to-air STINGER, air-to-air STINGER, and Air-to-Ground Missile System (AGMS) in a size compatible with the TOW launcher. The TACAWS demonstration program is the only advanced development Science and Technology program to develop and demonstrate the key enabling technologies to provide technology options for a missile to replace TOW (A replacement for TOW is needed immediately in the next century). The TACAWS demonstration program will transition technology to the TOW Follow-on Engineering and Manufacturing Development (EMD), PE 0604325A (Advanced Missile Systems - Heavy) program beginning in FY97/98. TACAWS will permit the testing of the key technologies before committing to a Demonstration/Validation program and will permit evaluation of potential P3I opportunities. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. Major contractors are Raytheon, Tewksbury, MA; TRW, Redondo Beach, CA; and Unisys, Salt Lake City, UT.

FY 1994 Accomplishments:

- Completed evaluation of multi-mission seeker (M^2S) through tower and captive flight tests (3500)
- Developed TACAWS seeker design (1800)
- Completed detailed design of flight test gel bi-propellant motor (2650)
- Completed evaluation of alternate gel bi-propellant motors as fallback option (1050)
- Conducted hardware design of radio frequency (RF) data link in support of flight test (1300)
- Completed end-to-end autotracker design and development for flight test (500)
- Completed evaluation of imaging infrared data compression techniques (423)
- Developed preliminary design of a ground platform prototype reconfigurable gunner's station simulator in support of Battlefield Distributed Simulation-Developmental (BDS-D) virtual and live experiments in a Distributed Interactive Simulation (DIS) environment (1500)
- Evaluated automatic target recognition schemes (800)
- Developed and conducted preliminary simulations of TACAWS missile and launch vehicle (4042)

FY 1995 Planned Program:

- Finalize seeker design and build five TACAWS seekers to support captive flight test, HWIL simulations, and flight tests (6010)
- Build-up flight test motor hardware components (2000)
- Complete design of gunner's station (1725)
- Finalize design and build ground platform prototype reconfigurable simulator gunner's station in support of BDS-D virtual and live experiments in a DIS environment (2616)
- Conduct hardware build of RF data link in support of flight test (1750)

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- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (275)

FY 1996 Planned Program:
- Complete integration of flight hardware (10336)
- Complete seeker captive flight tests (2280)
- Complete HWIL simulation of flight hardware (4701)
- Complete Six Degrees of Freedom (6DOF) simulation system evaluation and support missile flight tests (1820)

FY 1997 Planned Program:
- Design and fabricate gunner fire control console (1322)
- Complete technology demonstration flight tests and transition technology to TOW follow-on Engineering and Manufacturing Development (7927)

Project D380 - Multi-Platform Launcher (MPL): This project is part of the Rapid Force Projection Initiative (RFPI) ACTD for our early entry forces and is also tied to the Joint Precision Strike Demonstration (JPSD) Precision/Rapid Counter Multiple Rocket Launcher (MRL) ACTD. The MPL program will explore and implement technologies to improve the deployability and lethality of the MLRS system for counter battery, counter armor, and critical target missions. The first phase of the MPL program (FY 94 to FY 97) will design, develop, and flight test a low cost guidance and control system for the MLRS free-flight rocket, thereby substantially improving its delivery accuracy, reducing the number of rockets required to defeat the target, and expanding the set of MLRS targets to include precision targets. The guidance system will make use of inertial and Global Positioning System (GPS) low cost component technologies. A more accurate rocket results in both a more lethal force and a reduced logistics burden, which is especially important for early entry. The second phase of the program will support the design and testing of the High Mobility Artillery Rocket System (HIMARS), a C-130 transportable MLRS launcher. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. The major contractor is Loral Vought Systems, Dallas TX.

FY 1994 Accomplishments: Program not funded

FY 1995 Planned Program:
- Design and construct wind tunnel models and perform wind tunnel tests (200)
- Select, test and qualify the inertial measurement unit (IMU) (200)
- Perform guidance and control analyses (150)
- Design and test a prototype flight computer (302)
- Design and test a prototype control system (235)
- Design airframe modifications (250)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (28)

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FY 1996 Planned Program:

- Construct flight computers, algorithms and software (1250)
- Construct control actuation systems (1029)
- Design global positioning system (GPS) algorithms (200)
- Establish GPS antenna and receiver specifications (300)
- Develop electronic and power systems (400)
- Develop telemetry and flight termination systems (600)

FY 1997 Planned Program:

- Perform software integration and testing (520)
- Perform system integration and hardware-in-the-loop testing (850)
- Perform missile assembly and checkout (1209)
- Perform flight test planning (200)
- Perform five flight tests (1000)

Project D387 - Multi-Purpose Individual Munition (MPIM): This project provides for demonstration of a lightweight, shoulder fired, multiple purpose weapon. It provides the Army with one weapon capable of defeating enemy forces in buildings, bunkers, and lightly armored vehicles. The Multiple Purpose Individual Munition/Short Range Anti-tank Weapon (MPIM/SRAW) is capable of being fired from its carrying configuration and can be safely fired from an enclosure for the close battle. The MPIM/SRAW demonstration integrates warhead technology developed by the Army with the United States Marine Corps (USMC) propulsion system developed for SRAW. It will replace the AT4 system, which was only designed to defeat light armor. The system developed will have significantly improved lethality over the AT4, as well as being multiple target capable, which is particularly important in contingency operations. In FY97, producibility efforts will be initiated to reduce the cost of guidance hardware to reduce unit costs of the system. The technology will transition to the MPIM development program in PE 0604802A, Weapons and Munitions Engineering Development, at the end of FY97. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. The major contractor is Loral Aeronutronic, Rancho Santa Margarita, CA.

FY 1994 Accomplishments: Program not funded

FY 1995 Planned Program:

- Issue request for proposal (RFP) for demonstration and live fire tests of MPIM/SRAW system to include demonstration of MPIM warhead integration with USMC SRAW propulsion system (100)
- Evaluate proposals and select contractor to perform demonstration; award contract(100)
- Design and build subsystem for testing and contractor testing of hardware (5283)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (118)

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FY 1996 Planned Program:
- Fabricate system hardware and receive delivery for testing (3405)
- Conduct technology demonstration (970)
- Conduct accuracy and lethality evaluation (195)
- Conduct milestone review for entry into EMD (5)

FY 1997 Planned Program:
- Issue RFP for low-cost guidance (50)
- Award contract for delivery of low-cost guidance components (3342)
- Deliver and test guidance components (100)
- Integrate low-cost guidance components into MPIM/SRAW missile and test (300)
- Provide low-cost guidance technology to PEO Tactical Missiles to incorporate into MPIM/SRAW EMD program (100)

Project D401 - Insensitive Munitions (IM) for Missile Propulsion: This project developed and demonstrated propulsion systems with insensitive munitions properties for use in present and future Army missile systems to meet the requirements of the Joint Services Requirement for Insensitive Munitions (JSRIM) and the subsequent Army Insensitive Munition Policy. The program developed appropriate propulsion prototype systems and demonstrated techniques, propellants, shielding procedures, mitigating devices, safety guidelines and inert components. The insensitive munition (IM) technology emphasis was the application of IM technology to HELLFIRE. Work in this project was completed in FY'94. Work was performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. Major contractors were Hercules Incorporated, Cumberland, MD and Thiokol, Huntsville, AL.

FY 1994 Accomplishments
- Identified approaches and ingredients for high performance minimum signature propellants and inert structures to yield IM propulsion systems and demonstrate increased survivability of IM propulsion systems (1686)
- Formulated and initiated performance evaluation of survivable formulations for use in ducted rocket engine (DRE) and hybrid propulsion applications (300)
- Developed and evaluated new candidate oxidizers and energetic monomers/polymers (500)
- Demonstrated bi-propellant gel components (1533)
- Designed IM bi-propellant gel system based on tested components (300)
- Demonstrated ballistic and IM characteristics of composite propellant in a roll bonded test vessel (200)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

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FY 1997 Planned Program: Project not funded

Project D486 - Rapid Force Projection Simulation: The RFPI Simulation Support Plan and the RFPI Study Plan provide a detailed description of the simulation and analysis efforts underway to support the RFPI program. Scenario development, force-on-force modeling, and simulation are currently supported by detailed engineering models, preliminary system performance estimates/data, and other system models and simulations provided by the RFPI program and the individual Advanced Technology Demonstrations/ Technology Demonstrations (ATDs/TDs). All simulations and analysis will be performed under the guidance and supervision of the Integrated Battlefield Simulation and Analysis Team (IBSAT). Simulations and analysis will support the determination of value added of proposed technologies for the RFPI ACTD and will be utilized to determine the mix and number of developmental sensors to be used in the Advanced Warfighting Experiment (AWE) and subsequently to determining residual quantities and support requirements. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. Major contractors are Computer Science Corporation, Huntsville, AL; and Nichols Research Corporation, Huntsville, AL.

FY 1994 Accomplishments

- Established modeling requirements and measures of merit for candidate ATDs and aggregate RFPI force structures (500)
- Examined RFPI ACTD combat effectiveness using Dismounted Battlespace Battle Lab simulations (3000)
- Implemented light force anti-armor scenario High Resolution Scenario (HRS) 33.7 in Janus and Battlefield Environmental Weapon Systems Simulation (BEWSS) (475)
- Established RFPI Battlefield Distributed Simulation - Developmental (BDS-D) node (500)
- Provided simulation support to Early Version Demonstration (EVD) (3000)

FY 1995 Planned Program:

- Support RFPI Early Version Demonstration post experiment reviews (500)
- Implement HRS 33.7 in Combined Arms Support Task Force Evaluation Model (CASTFOREM) (750)
- Expand virtual prototyping and synthetic battlefield capability (2500)
- Expand virtual/live link capabilities (1000)
- Develop interface requirements between Battlefield Distributed Simulation - Developmental (BDS-D) and RFPI constructive simulations (848)
- Provide simulation support to early version demonstration of multi-sensor/shooter concept (34)
- Perform sensitivity analyses to identify preferred RFPI element mixes (200)
- Develop specifications for BDS-D interface with candidate ATDs (1000)
- Provide detailed planning and development for experiment #6 in support of Anti-Armor ATD (A2ATD) (250)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (152)

FY 1996 Planned Program:

- Perform record runs, document and staff run matrices for BEWSS, JANUS, and CASTFOREM (3450)

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- Execute EFOG-M Virtual Prototype Demonstration (VPD) AWE (1500)
- Integrate follow-on scenarios into BEWSS, JANUS, and CASTFOREM (995)

FY 1997 Planned Program:
- Document results of BEWSS, CASTFOREM, and JANUS runs (1583)
- Perform BEWSS record runs Command and Control (C2) simulations (2500)
- Execute Battle Lab Warfighting Experiment (BLWE) virtual exercise in preparation for ACTD AWE (1500)
- Plan and rehearse ACTD (2000)
- Perform final predictions for ACTD Model-Test-Model (500)

Project D493 - Rapid Force Projection Demonstration: The integrated system of systems concept of this ACTD provides lightweight, responsive precision fires to destroy threat armor forces during day, night, and adverse weather. This ACTD will evaluate the value added by the insertion of these new technologies into the force structure of an existing light unit in a lift constrained environment. The inserted systems will consist of forward sensors (hunters), advanced command and control (C2), and a suite of standoff killers. The mix of forward sensors used to complement and enhance existing unit assets includes both manned and unmanned air and ground systems. The sensor architecture will be based on the unit equipment, as documented in the U.S. Army Intelligence Master Plan and the U.S. Army Modernization Plan; and will be augmented with other sensors and processors, as required, to ensure forward sensors are properly cued. Tactical sensors (organic and advanced) will receive cueing information from these sensors to rapidly focus them on targets. The mix of standoff killers complements and extends the capabilities of current systems. The EFOG-M, a Brigade asset, is a lightweight, man-in-loop non-line of sight guided missile which is lethal against a variety of high priority targets, including heavy armor. Howitzers are organic to the Division and Corps artillery and operate in direct and general support of the Maneuver Brigade. The exact mix of 105/155 mm howitzers will be determined by the AWE manager in conjunction with the Forces Command (FORSCOM) Unit, and the Depth and Simultaneous Attack Battle Lab (D&SA BL). The HIMARS, a lightweight and highly mobile artillery rocket and missile firing platform which uses a wheeled chassis, will be a Corps asset which is attached to the Maneuver Brigade. The deployability of the Division Ready Brigade Minus (DRB(-)) will not be affected throughout the evaluation of the systems. This ACTD will include both simulation and field demonstration phases, and will encourage User exploration of excursions from the baseline Tactics, Techniques, and Procedures (TTPs) to optimize utility of the standoff killers, forward sensors, and advanced C2 for the light forces. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. Major contractors are Nichols Research Corporation, Huntsville, AL; and Computer Sciences Corporation, Huntsville, AL.

FY 1994 Accomplishments:
- Established demonstration scenarios and defined demonstration architecture (250)
- Developed interface requirements for RFPI ATDs and BDS-D components (250)
- Assessed new technologies for inclusion into RFPI (45)
- Conducted an early version of ACTD with emphasis on sensor to shooter connectivity (320)
- Completed preliminary site survey for ACTD location (113)

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- Conducted concept trade-off analysis for multi-platform launcher/guided rocket (430)

FY 1995 Planned Program:
- Initiate development of real time control system (800)
- Develop interface requirements, specifications, and implementation plan for the RFPI ACTD (800)
- Develop interface specifications for integrating candidate ATDs (300)
- Assess new technologies for inclusion into RFPI (1000)
- Finalize specification of ACTD configuration/optional elements (600)
- Interface with US Army digitization efforts and plans (479)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (85)

FY 1996 Planned Program:
- Test and validate hunter suite (2500)
- Design HIMARS including Critical design Review (CDR) (4500)
- Order long-lead items for HIMARS, including vehicles, launcher components, and raw materials (3500)
- Initiate fabrication of HIMARS prototypes/surrogates (500)
- Verify and validate plan for DIS simulators (250)
- Test Intelligent Mine Field (IMF) components (1550)
- Test Remote Sentry components (1500)
- Develop standard military equipment list (250)
- Finalize C2 system of Light Tactical Operations Center (TOC) 2 (3417)

FY 1997 Planned Program:
- Complete HIMARS design (2500)
- Initiate developmental testing of HIMARS (2000)
- Continue fabrication of HIMARS prototypes/surrogates (2900)
- Initiate safety qualification and man rating evaluations of HIMARS (1500)
- Integrate HIMARS into RFPI evaluations (1000)
- Review and approve all ATD/TD training packages (300)
- Conduct and complete captive flight tests of sensors (1750)
- Train and integrate elements at test installation (350)
- Test and integrate 105mm/155mm Howitzer (3250)
- Acquire equipment and spares for ACTD AWE (1080)

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- Address producibility issues (1598)
- Integrate ACTD AWE systems (6589)

Project D496 - Enhanced Fiber Optic Guided Missile (EFOG-M): The Enhanced Fiber Optic Guided Missile (EFOG-M) is the primary anti-tank "killer" within the "hunter/standoff killer" concept of the RFPI ACTD. The EFOG-M system is a multi-purpose, precision kill weapon system. The primary mission of the EFOG-M is to engage and defeat threat armored combat vehicles, other high value ground targets, and hovering or moving rotary wing aircraft that may be masked from line of sight direct fire weapon systems. EFOG-M is a day/night, adverse weather capable system that allows the maneuver commander to extend the battle space beyond line of sight to ranges up to 15 kilometers. The system consists of a gunner's station, a tactical missile, and a fiber optic data link. The missile can navigate to the target area, and the gunner can intervene at any time to lock on and engage any detected targets. The gunner views the flightpath and target via a seeker on the missile linked to the gunner's video console. The missile to be demonstrated will incorporate an IR imaging seeker, a variety of advanced targeting functionalities and a global positioning system (GPS)-based inertial measurement unit for accurate targeting. The RFPI ACTD will demonstrate airlift constrained, enhanced power projection capabilities through the development and evaluation of new technologies and tactics for early entry forces. This ACTD will demonstrate a semi-automated target transfer from forward sensors (hunters) to an EFOG-M weapon system (killer) using C3 integration, and will fully explore the capability to expand the brigade level battle space through the use of simulation, TRADOC Battle Lab warfighting experiments and demonstrations. The ACTD will demonstrate the ability to conduct essential targeting and intelligence collection using forward sensors and real-time communications to provide for precision engagements against a variety of high priority targets, including armored vehicles. An integral element of the ACTD concept is allowing the participating unit to retain developmental items from the ACTD to provide residual operational capability.

FY 1994 Accomplishments:
- Evaluated EFOG-M contract proposals; completed preparations for award (600)
- Prepared test plans for technology demonstrations (698)
- Develop virtual prototype experiment (VPE) hardware and software (pending resolution of protest) (9023)

FY 1995 Planned Program:
- Fabricate VPE Hardware (4274)
- Initiate design, fabrication and test of EFOG-M developmental missiles, fire units, and Platoon Leader vehicles (28592)
- Integrate and manage design and fabrication effort (7025)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (856)

FY 1996 Planned Program:
- Participate in a virtual prototype experiment (2085)
- Continue design, fabrication and test of EFOG-M developmental missiles, fire units, and Platoon Leader vehicles (43777)
- Initiate the manufacture of EFOG-M missiles, fire units, and Platoon Leader vehicles to support user conducted field training exercises (14749)
- Integrate and manage design and fabrication effort (8749)

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FY 1997 Planned Program:

- Complete design, fabrication and test of EFOG-M developmental missiles, fire units, and Platoon Leader vehicles (24058)
- Continue the manufacture of EFOG-M missiles, fire units, and Platoon Leader vehicles to support user conducted field training exercises for an extended user evaluation (25077)
- Integrate and manage design and fabrication effort (9430)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	46438	94602	125284	98575
Appropriated Value	46438	77212		
Adjustments to Appropriated Value	-1385			
a. SBIR/STTR decrement (-719)				
b. Reprogramming (-666)				
Current President's Budget Submit	45053	77212	123913	112429

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PROJECT: D206

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D206 Missile Simulation	3765	3825	3150	4044	4986	5547	6600	6691	Continuing	Continuing

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete Digital Signal Processor				X*												
Demo improved HWIL Sim. Software																X
Demo IR Scene Projector Capability																X
Demo Distributed Interactive Simulation Capabilities in Operational Exercise																X

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

PROJECT: D263

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D263 The Army Combined Arms Weapon System (TACAWS) Technology Demonstration(s)	17565	14376	19137	9249	1032	5008	18985	22946	Continuing	Continuing

C. Other Program Funding Summary: See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete Evaluation of MMS				X*												
Complete Design of Gunner's Platform						X										
Finalize Seeker Design and Build Five Seekers								X								
Complete Integration of Flight Hardware												X				
Complete Seeker Captive Flight Tests												X				
Complete HWIL Simulation of Flight Hardware												X				

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

PROJECT: D380

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D380 Multi-Platform Launcher	0	1365	3779	3779	8954	11942	16987	19953	Continuing	Continuing

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Construct 6-DOF simulation				X*												
Conduct wind tunnel tests						X										
Construct & test prototype hardware								X								
Construct flight hardware											X					
Perform missile assembly and checkout														X		
Perform flight tests																X

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

PROJECT: D387

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D387 Multi-Purpose Individual Munition	0	5601	4575	3892	0	0	0	0	0	14060

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demonstrate MPIM warhead integration on SRAW propulsion system					X*											
Select contractor for demonstration						X										
Complete contractor system tests										X						
Complete fabrication of tech demo system											X					
Award producibility contract													X			
Delivery & test of guidance components															X	
Integrate low cost guidance into MPIM/SRAW																X

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

PROJECT: D401

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D401 Insensitive Munitions for Missile Propulsion	4519	0	0	0	0	0	0	0	0	17556

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demo Bi-propellant Gel Components				X*												
Demo Ballistic and IM Characteristics				X*												

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

PROJECT: D486

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D486 Rapid Force Projection Simulation	7475	7234	5945	8083	8689	5308	0	0	0	43359

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Provide Sim support to Early Version Demo				X*												
Sim support to FY95 Advanced Warfighting Experiments (AWEs)								X								
Complete virtual prototype of Hunter, MICOM											X					
Complete RFPI early entry scenario excursions												X				
Sim support to A2 ATD & FY96 AWEs												X				
Complete Hunter Virtual Prototype at Dismounted Battlespace Battle Lab (DBBL)															X	
Simulation support to early entry demo																X
2nd Hunter testbed to support Battle Labs																X

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

PROJECT: D493

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D493 Rapid Force Projection Demonstration	1408	4064	17967	24817	30783	28928	14189	11971	Continuing	Continuing

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct Early Version Demonstration of TLD				X*												
Participate in Battle Lab AWEs						X										
Complete real time control system (RTCS)									X							
Participate in A2 ATD/other FY95 Demos										X						
Element testing												X				
Begin home station train-up																X

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603313A Missile And Rocket Adv Tech

PROJECT: D496

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D496 Enhanced Fiber Optic Guided Missile (EFOG-M) Demonstration	10321	40747	69360	58565	53318	23775	8993	0	0	265291

C. **Other Program Funding Summary**: See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Release EFOG-M Request for Proposal		X*														
Award EFOG-M Contract					X*											
Conduct Virtual Prototype Demonstration (VPE)									X							
Conduct Design Review II											X					

* Denotes completed effort

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare & Barrier Adv Tech

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	9827	21612	18820	15649	16941	14578	14371	14054	Continuing	Continuing
D006 Landmine Warfare Development	2294	0	0	0	0	0	0	0	0	2294
D608 Countermine & Barrier Development	7533	21612	18820	15649	16941	14578	14371	14054	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element provides advanced technology demonstrations of countermine capabilities. Mines employed against our forces have the effect of complementing natural obstacles, enhancing the effectiveness of anti-armor and artillery weapons, and slowing, canalizing, and injuring our soldiers and damaging or destroying our equipment. The countermine program developed under Project D608 is a cooperative effort with the U.S. Marine Corps (USMC) directed at negating the effects of threat mines by developing means to detect and neutralize them. The detection and neutralization activities have been structured to form the Army's Science and Technology (S&T) portion of the countermine (CM) program. The CM program uses five advanced technology demonstrations (ATDs) (3 Army, 2 USMC), four advanced warfighting experiments, and modeling and simulation to verify the system of systems approach, providing support for the shallow water/beach/land assault phase (Demo 1) of the Navy, Army, and USMC joint countermine advanced concepts technology demonstration (ACTD). The specific efforts include remote detection of minefields, detection of individual mines from moving vehicles and advanced hand held detectors, all of which must work against both traditional (metallic) mines and mines made from advanced materials. Breaching techniques must also be developed for both conventional and electronically activated mines that can act at a distance. The Army's deficiencies in countermine capabilities were highlighted by Operation Desert Storm (ODS), where large numbers of advanced mines hindered the mobility of the U.S. and allied forces. Mines are becoming increasingly sophisticated and available world wide at low cost, thereby representing a significant threat to U.S. forces in power projection situations. Even small numbers of unsophisticated mines negatively impact operations, as witnessed by the U.S. humanitarian operations in Somalia. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on conventional air/surface weaponry and ground vehicles, with oversight provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with PE 0602784A (Military Engineering Technology) and PE 0602786A (Logistics Technology) and contains no unwarranted duplication of effort among the Military Departments. This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA. This program is dedicated to conducting proof of principle field demonstrations and tests of system specific technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

Project D006 - Landmine Warfare Development: Landmine warfare development includes improved sensors, mine command and control data links, target discrimination logic, and explosive mechanisms to improve the effectiveness, lethality and application of mines. The intelligent minefield (IMF) concept will demonstrate the flexibility and battlefield effectiveness of a coordinated smart mine attack utilizing artificial intelligence (AI), decision aids, identification friend-or-foe (IFF), inter-mine communications, and command and control. This is a key part of the Rapid Force Projection Initiative which will demonstrate enhanced lethality for the early entry forces. This program has been restructured to PE 0603004A beginning in FY 1995 to consolidate weapons and munitions advanced technology in a single PE.

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603606A Landmine Warfare & Barrier Adv Tech

FY 1994 Accomplishments:
- Conducted IMF demonstration of software and hardware interfaces (765)
- Installed preliminary IMF models into Armaments Research, Development and Engineering Center (ARDEC) simulation test bed (748)
- Developed detailed designs for IMF field demonstrations(781)

FY 1995 Planned Program: Project not funded

FY 1996 Planned Program: Project not funded

FY 1997 Planned Program: Project not funded

Project D508 - Countermine and Barrier Development: Operation Desert Storm and the humanitarian operations in Somalia have highlighted the need for new equipment to detect and neutralize land mines. As an interim solution, mine clearing rakes were fabricated and successfully used to breach minefields during Operation Desert Storm. The Army's highest priority requirements are in-stride detection and breach, and man-portable stand-off and close-in detection and neutralization of landmines. Mine detection and neutralization efforts are applicable to the full range of conflict, from heavy force scenarios to low intensity conflicts. Close-in man portable mine detectors will use multi-sensor fusion to augment and complement present metal detectors in discriminating mines from clutter. Similarly, multi-sensor fusion will be used in a vehicle-mounted mine detector system to sense surface-laid and buried mines. The Army has focused its resources and is expediting these programs in coordination with the US Marine Corps.

FY 1994 Accomplishments:
- Fabricated and lab tested ground penetrating radar and electro-optic sensors for vehicle mounted mine detector test beds and evaluated results of FY 1993 field test (3652)
- Built and initiated testing of three ground penetrating radars and one infrared close-in man portable mine detector test bed (2881)
- Tested and evaluated commercial-off-the-shelf (COTS) handheld thermal infrared cameras by using them to successfully detect mines and buried explosives along major supply routes in Somalia (1000)

FY 1995 Planned Program:
- Field test and evaluate performance of ground penetrating radar and electro-optic vehicle mounted mine detector test beds (4058)
- Demonstrate countermeasure techniques to overcome terminal sensors (infrared (IR), millimeter wave (MMW)) of top and side attack mines using smart mine emulator developed in PE 0602786A/AH20 (1000)
- Demonstrate and evaluate performance of close-in man portable mine detector test beds; and finalize program management documentation for transition to development (3800)
- Conduct "expand the lodgment" and "beach break through" field experiments and accompanying simulations as part of a countermine field demonstration (2497)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603606A Landmine Warfare & Barrier Adv Tech

- Develop and demonstrate technologies specifically appropriate for demining in operations other than war, to include low cost vehicle mounted mine detector, low cost airborne mine detection/reconnaissance, low cost explosive devices for neutralization and destruction of mines in place, and individual components such as demining tool kits (9803)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (454)

FY 1996 Planned Program:

- Demonstrate countermeasure techniques to overcome technical sensors of top and side attack mines using smart mine emulator and finalize program management documentation for transition to development (2200)
- Complete sensor fusion algorithms; initiate build and integration of hardware and software for vehicle mounted mine detector demonstrators (4714)
- Conduct "expand the lodgment" and "beach break through" advanced warfighting demonstrations (4500)
- Complete Phase I of Joint Countermine advanced concept technology demonstration (ACTD) modeling and simulation effort, complete procurement of multiple manportable, vehicle mounted, and airborne mine detection prototypes; define C4I requirements and architecture and procure C4I equipment (7406)

FY 1997 Planned Program:

- Demonstrate and evaluate performance of vehicle mounted mine detector test bed and finalize program management documentation for transition to development (6650)
- Conduct "movement to contact" modeling and simulation studies and small scale field experiments (2444)
- Complete simulation, analysis, and pre-demonstration exercises of C4I architecture; and conduct ACTD Demonstration I at Camp Lejeune, NC in conjunction with United States Atlantic Command (USACOM) forces (6555)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	9982	11950	11414	8594
Appropriated Value	9982	21612		
Adjustments to Appropriated Value	-155			
SBIR/STTR decrement (-155)				
Current President's Budget Submit	9827	21612	18820	15649

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare & Barrier Adv Tech

PROJECT: D006

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D006 Landmine Warfare Development	2294	0	0	0	0	0	0	0	0	2294

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct IMF demonstration of software and hardware interfaces				X*												

*Denotes completed milestone

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603606A Landmine Warfare & Barrier Adv Tech

PROJECT: D608

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D608 Countermine & Barrier Development	7533	21612	18820	15649	16941	14578	14371	14054	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Fabricate and lab test ground penetrating radar and eletro-optic sensors				X*												
Demonstrate Close-In Man Portable Mine Detector test beds								X								
Develop and demonstrate technologies for demining in OOTW								X								
Demonstrate countermine techniques to overcome top and side attack mines												X				
Complete Phase I of Joint Countermine ACTD modeling and simulation effort												X				
Demonstrate performance of Vehicle Mounted Mine Detector test bed																X
Complete simulation, analysis, and pre-demonstration of C4I architecture																X

*Denotes completed milestone

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603607A Joint Service Small Arms Program

PROJECT: D627

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D627 Joint Service Small Arms Program (JSSAP)	7405	7163	4487	5381	4897	5322	5187	5886	Continuing	Continuing

A. Mission Description and Budget Item Justification The objective of this Program Element (PE) is to demonstrate key technologies leading to more effective small arms weapons and munitions for all Services. The Joint Services Small Arms Program is designed to overcome the technological barriers associated with small arms/munitions/fire control for individual and crew-served weapons. The goal is to achieve substantial improvements in threat defeat under all environmental conditions while reducing the soldier's load. This PE funds several efforts, including the following: (1) Objective Individual Combat Weapon (OICW) Advanced Technology Demonstration (ATD), the lethality portion for the 21st Century Land Warrior (21CLW) program, which will provide a 200% to 300% increase in incapacitation probability and increase range to 1000 meters; (2) Objective Crew Served Weapon (OCSW), which will demonstrate the next generation crew-served weapon to replace selected M249 Squad Automatic Weapons, the M60 machine gun, the M2 machine gun, and the MK19 grenade machine gun (GMG) with a 2-solder portable system that maintains comparable firepower while featuring a 60-75% weight reduction; (3) Multi-platform Ballistic Sight (MPBS), for an all weather day/night capability against materiel and personnel, increasing first burst hit probabilities from the present 15% to 90%; (4) Modular Fire Control to reduce life cycle cost and improve effectiveness; (5) Controlled Penetration Ammunition, intended to minimize collateral damage in confined operational environments; and (6) Training Ammunition, to yield realistic training with 50-90% range reduction. All JSSAP efforts are based upon approved Joint Service Science and Technology Objectives (JSSTO) and the Joint Service Small Arms Master Plan (JSSAMP) which are drawn from the following Service documents: The Army Battlefield Development Plan and Small Arms Master Plan, the U.S. Marine Corps' (USMC) emerging Advanced Small Arms Plan, the Special Operations Command Destructive Capabilities Master Plan, the Air Force Air Base Ground Defense, Navy requirements, and the Coast Guard Small Arms Master Plan. The work in this PE is consistent with the resource constrained Army Science & Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armaments Research, Development and Engineering Center, Picatinny Arsenal, NJ. Major contractors include: Olin Corp., East Alton, IL; Contraves USA, Pittsburgh, PA; Alliant Tech Systems, Hopkins, MN; and AAI Corp., Hunt Valley, MD. Work in this Program Element is related to and fully coordinated with efforts in PE 0602623A (Joint Service Small Arms Program), PE 0602624A (Weapons & Munitions Technology), and transitions to work performed in PE 0604802A (Weapons & Munitions-Engineering Development). This program is dedicated to conducting proof of principle field demonstrations and tests of system-specific technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

Project D627 - Joint Service Small Arms Program:

FY 1994 Accomplishments:

- Completed performance verification testing, evaluation, and report of fire control system for ground mounted machine gun (M2 Cal .50 out to 2000 meters
- and MK19 out to 1400 meters) (525)
- Fabricated and tested a prototype multi-platform ballistic sight and developed baseline data for Joint Service use (2307)
- Awarded multiple OICW contracts and conducted systems analysis and conceptualization detailing performance, weight and cost of system (1895)
- Completed evaluation of initial designs for low collateral damage rifle ammunition and initiated fabrication of refined design (440)
- Integrated such efforts of USMC interest as the Combat Shotgun into the program (1993)

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BUDGET ACTIVITY: 3 - Advanced Development	PE NUMBER AND TITLE: 0603607A Joint Service Small Arms Program / PROJECT: D627

- Refined Cal .50 Limited Range Training Ammunition (LRTA) interior ballistics (245)

FY 1995 Planned Program:

- Complete evaluation of final design for multi-platform ballistic sight (200)
- Conduct technology demonstration of multi-platform ballistic sight and prepare for transition (505)
- Complete Objective Individual Combat Weapon (OICW) system conceptualization (2867)
- Conduct OICW concept technology review and downselect to a single contractor based upon projected performance, weight and cost of system (2800)
- Finalize Cal .50 LRTA design and initiate fabrication of performance verification hardware (135)
- Establish final design of low collateral damage rifle ammunition and fabricate performance verification hardware (135)
- Award contract for Joint Combat Shotgun test and evaluation hardware (393)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (128)

FY 1996 Planned Program:

- Demonstrate critical sub-system component technologies for OICW (1528)
- Initiate OICW prototype system integration and build prototype weapon (1480)
- Perform contractor demonstration of prototype OICW (820)
- Verify Cal .50 limited range training ammunition performance (67)
- Test/evaluate Joint Combat Shotgun and prepare for type classification and production (592)

FY 1997 Planned Program:

- *Initiate OICW system build for 21 CLW and OICW ATD (1662)*
- Conduct operational evaluation of the OICW prototype fire control (435)
- Initiate OCSW prototype system fabrication (2827)
- Verify low collateral rifle ammunition performance (215)
- Complete 7.62mm Long Range Sniper Cartridge performance verification (242)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	7522	5746	4486	5379
Appropriated Value	7522	7163		
Adjustments to Appropriated Value	-117			
a. SBIR/STTR decrement (-117)				
Current President's Budget Submit	7405	7163	4487	5381

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603607A Joint Service Small Arms Program
	PROJECT D627

C. **Other Program Funding Summary** See Paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete performance verification of machine gun fire control				X*												
Complete evaluation of OICW concepts					X											
Complete evaluation of MPBS							X									
Demonstration of MPBS technology								X								
Demonstrate critical component technologies for OICW									X							
Demonstrate Cal .50 training ammo												X				
Demonstrate OICW prototype												X				
Build OICW prototypes for 21 CLW															X	
Demonstrate OICW system technology															X	
Complete OCSW prototype design															X	
Demonstrate low collateral damage Rifle Ammunition															X	

* Denotes a completed effort

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603654A Line-Of-Sight Anti-Tank Weapon System (LOSAT)

PROJECT: D460

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D460 LOSAT Technology Demonstration	5122	4871	14727	18707	13432	0	0	0	0	192619

A. Mission Description and Budget Item Justification This program focuses on 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. LOSAT is a mobile, direct fire, antitank system and provides overwhelming lethality with a high rate of kill at long range. The LOSAT weapon system consists of a kinetic energy (KE) missile launcher mounted on an armored combat vehicle chassis. The LOSAT program was restructured to advanced development in FY 1992 in order to complete an evaluation of the fire control system and to study further the utility of the LOSAT technologies on an air mobile system before commitment to the formal acquisition process. The current program provides for the conduct of an early entry force demonstration program which includes the design, fabrication, and integration of a LOSAT system turret into an Armored Gun System (AGS) chassis, conduct of a missile flight test program from the AGS based LOSAT fire unit, and limited user testing. The demonstration program is a cost-effective means to assess the utility of LOSAT to the early entry force as part of the Rapid Force Projection Initiative (RFPI). The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan and Project Reliance. This program is dedicated to conducting proof of principal field demonstrations and tests of technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3. Work on this program is conducted through the LOSAT Project Office in Huntsville, AL. The prime contractor is Loral Vought Systems in Dallas, TX.

Project D460-LOSAT Technology Demonstration: This project will develop improved technologies for KE missile defeat of robust armor targets and evaluate integration of the LOSAT capability into an air mobile configuration to help remedy the early entry force's lethality shortfall against heavy armors. Project objectives are to position the technology for future acquisition decisions, demonstrate subsystem capabilities in flight tests and dirty battlefield environment, evaluate the utility of the LOSAT technology for the early entry forces, demonstrate an integrated AGS based LOSAT system in flight test and advanced warfighting experiments, and evaluate affordablity issues.

FY 1994 Accomplishments:

- Procured and started fabrication of the AGS chassis (5122)

FY 1995 Planned Program:

- Assemble missile to support LOSAT/Bradley Fighting Vehicle (BFV) flight test program (869)
- Provide contractor test and evaluation (T&E) support to LOSAT/BFV flight test program (1200)
- Provide government/White Sands Missile Range (WSMR) T&E support to LOSAT/BFV flight test program (1000)
- Design, fabricate/integrate Weapon System Turret Assembly (WSTA) for an Armored Gun System (AGS) chassis based system (700)
- Support Distributed Interactive Simulation Crew Station Simulator (DISCSS) activities to include participation in Rapid Force Projection Initiative (RFPI) analysis simulation effort and in Anti-Armor advanced technology demonstration (A^2ATD) experiments (1000)

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603654A Line-Of-Sight Anti-Tank Weapon System (LOSAT)

- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (102)

FY 1996 Planned Program:

- Design, fabricate/integrate WSTA for AGS chassis based system (10000)
- Support DISCSS activities to include participation in RFPI and A^{2}ATD (1500)
- Begin integration of the WSTA into the AGS chassis to form the LOSAT prototype (2400)
- Support test site preparation at WSMR (827)

FY 1997 Planned Program:

- Complete the integration of the WSTA into the AGS chassis to form the LOSAT prototype (10700)
- Support contractor test preparation activities for LOSAT/AGS FY98 flight test program (1200)
- Support government/WSMR test preparation activities for LOSAT/AGS FY98 flight test program and Advanced Warfighting Experiments (AWE) testing (2700)
- Support Second Generation FLIR and DISCSS activities to include participation in RFPI and A^{2}ATD (4107)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	5000	4937	2000	0
Appropriated Value	5000	4871		
Adjustments to Appropriated Value	122			
a. SBIR/STTR decrement (-78)				
b. Reprogramming (200)				
Current President's Budget Submit	5122	4871	14727	18707

C. Other Program Funding Summary Not Applicable.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Initiate Weapon System Turret Assembly (WSTA) prototype fabrication				X*												
Initiate Armored Gun System (AGS) prototype Chassis Procurement					X*											

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603654A Line-Of-Sight Anti-Tank Weapon System (LOSAT)

PROJECT: D460

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete LOSAT/BFV missile flight test program						X										
Complete fabrication of missiles to support LOSAT/AGS flight test program							X									
Complete WSTA prototype fabrication											X					
Deliver AGS Prototype Chassis												X				
Initiate WSTA/AGS Chassis Integration												X				
Complete WSTA/AGS Chassis Integration															X	
Start Advanced Warfighting Experiments (AWE) User Testing															X	
Complete AWE User Testing																X

* Denotes completed effort

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	33324	33177	37969	37193	31544	41962	43915	42401	Continuing	Continuing
DK70 Night Vision Advanced Technology	20178	16668	19201	18815	12912	18665	17936	16461	Continuing	Continuing
DK86 Night Vision, Airborne Systems	8049	7799	9383	5908	7778	9858	10492	10975	Continuing	Continuing
DK87 Night Vision, Combat Vehicles	5097	8710	9385	12470	10854	13439	15487	14965	Continuing	Continuing

A. **Mission Description and Budget Item Justification:** This program element (PE) develops new and improved tactical night vision and electro-optics target acquisition and pilotage sensor technology for infantry, anti-armor, air defense, combat vehicle, and airborne applications. The development of this high performance target acquisition and engagement technology is essential to meet the target servicing, night pilotage, and driving requirements of future weapon systems. This technology will provide the capability to acquire and engage hostile targets at extended ranges during day/night, smoke, obscured weather and battlefield conditions, significantly enhancing the warfighting capability and survivability of US systems. In addition, multisensor target acquisition suites are demonstrated which meet the stringent fire control requirements of combat vehicles. These sensor suites are developed to provide the range and sensitivity necessary to align with the target engagement capabilities inherent in weapon fire control systems of ground vehicles. Efforts are also directed toward technology for wide field-of-view (FOV) sensors to support day/night nap-of-the-earth pilotage at high speeds. This PE will provide the target acquisition sensors for the advanced vehicle technologies, Rapid Force Projection Initiative (RFPI), and 21st Century Land Warrior (21 CLW) integrated technology program demonstrations. Technology advances achieved under this PE have tri-service applications. Work in this program element is consistent with the resource-constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance agreements on sensors and electronic devices with oversight and coordination provided by the Joint Directors of Laboratories. This work is related to and fully coordinated with efforts in program elements 0602709A/DH95, Night Vision Technology; 0602270A, Electronic Warfare Technology; 0603774A, Night Vision Systems Advanced Development; and 0604710A, Night Vision Systems Engineering Development. There is no unnecessary duplication of effort within the Army or DoD. Work in this PE is primarily managed by the US Army Communications-Electronics Research, Development and Engineering Center (CERDEC), Ft. Monmouth, NJ. Contractors include: Texas Instruments, Inc., Dallas, TX; Hughes Aircraft Co., El Segundo, CA; Fibertek, Herndon, VA; Questech, Falls Church, VA; Westinghouse, Linthicum, MD; Martin-Marietta Corp., Orlando, FL; Alliant, Hopkins, MN; EOIR, Spotsylvania, VA; Booze-Allen, McLean, VA; Omar McCall, Beltsville, MD. This project includes proof of principle demonstrations and tests of system-specific technologies to meet specific military needs and is therefore appropriately placed in Budget Activity 3.

Project DK70 - Night Vision Advanced Technology: This project will develop and demonstrate high performance, sensor/multisensor technology to meet the target servicing requirement for weapon systems upgrades. Emphasis is placed upon development of multisensor aided targeting technology for aviation and second generation (gen) hunter sensor suite applications, and remote sentry technology for RFPI. In addition, this project addresses individual soldier applications for 21 CLW, including manportable integrated sight technology and helmet mounted display vision systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology

FY 1994 Accomplishments:

- Completed integration of forward looking infrared (FLIR) and Longbow sensors to UH-60 surrogate and integrated multi-sensor aid targeting (MSAT)-air technology demonstrations in surrogate airborne platform to conduct field trials in preparation for flight demonstration/testing (11342)
- Designed remote sentry hardware and conducted early warfighting demonstrations and integrated simulation with the Army's Dismounted Battlespace Battle Laboratory (2650)
- Developed display electronics for interim display for helmet mounted vision system (450)
- Initiated development of components for manportable integrated sight thermal imaging, laser rangefinder, electronic compass, and laser pointer (1345)
- Designed and conducted early warfighting demonstrations of an extended range second generation/aided target recognition hunter sensor suite advanced technology demonstration (ATD) with on-line targeting and transferred to non-line-of-sight weapon platforms (4391)

FY 1995 Planned Program:

- Conduct MSAT-air field testing and flight demonstration of multi-sensor fusion. Transition tech data package to Comanche (1100)
- Deliver equipment and test remote sentry ATD components (4485)
- Develop display interfaces and integration approach for objective (2K x 2K) Advanced Research Projects Agency high resolution display (338)
- Complete development of integrated sight module critical components (1900)
- Package and integrate sensors for the hunter sensor suite ATD program in preparation for FY96 demonstration (8518)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (327)

FY 1996 Planned Program:

- Complete integration and demonstrate remote sentry ATD hardware (1000)
- Complete system design and begin integration of objective head mounted vision system (1166)
- Complete critical component testing and initiate integrated sight assembly fabrication and integration (3000)
- Integrate and demonstrate the hunter sensor suite on the hunter surrogate vehicle and deliver to RFPI advanced concept technology demonstration (14035)

FY 1997 Planned Program:

- Complete fabrication and integration of 21 CLW head mounted vision system (1450)
- Complete fabrication and integration of integrated sight modules (3900)
- Integrate hunter sensor suite with aided target recognition on alternate hunter surrogate vehicle (12158)
- Based upon advances in advanced focal plane arrays under PE 0602709A, implement design of advanced target acquisition sensor suite (1307)

Project DK86 - Night Vision Airborne Systems: This project concentrates on the development and flight evaluation of night pilotage systems, imaging sensor and display technology and automated obstacle warning technology to meet the night nap-of-the-earth (NOE) requirements of future aviation platforms, and on enhancing the operational capabilities and survivability of currently fielded attack, scout, cargo and utility helicopters. *This technology will significantly enhance the survivability of*

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology

Army aviation assets by permitting rotorcraft to fly at NOE altitude/airspeed profiles and avoid natural obstacles and wires in day/night/adverse weather conditions, thereby significantly reducing exposure to air defense artillery, and radar and heat seeking missile threats. Technology includes high-performance multi-sensor pilotage technology and single-sensor advanced image intensification (I2) technology for lower-cost applications. Current aviation systems are single-sensor (FLIR or I2) with limited field of view (40 deg). Research and flight experience have shown that dual spectrum (FLIR and I2) pilotage sensors are needed to provide a robust capability for NOE flight in low-light-level and adverse-weather conditions. The FLIR supports flight in low-light-level conditions; the I2 sensor, in conditions with low thermal signature. Increased field of view is needed for improved situation awareness and to reduce pilot workload. In addition, the imagery must be of high quality (improved resolution and, in the case of thermal sensors, adequately sampled). The advanced helicopter pilotage (AHP) demonstration will provide, in both demonstration hardware and flight evaluation, a high-quality dual-spectral pilotage sensor with the field of view and resolution required for advanced aircraft, and the displays needed to provide this imagery to the pilot. It is the only Army program demonstrating this capability. Benefits include both demonstration of the technical feasibility of components (I2 tubes and high-frame-rate focal plane, data bus, and image processing electronics) for Comanche and for future aviation pilotage sensor upgrades, and flight evaluation data to permit the user to better write the pilotage sensor requirements and the developer to write pilotage sensor specifications. The advanced image intensification (AI2) technology demonstration provides an improved night vision goggle capability with higher resolution, larger field of view, and integrated symbology; it will demonstrate technology for applications where an advanced, dual-spectral sensor is not affordable, but additional capability over existing goggles is needed. These applications include utility and cargo aircraft, and the mounted and dismounted soldier, including 21 CLW. The aerial scout sensor suite supports RFPI. Technology developed under Project DK86 is also directly applicable to the night flying requirements of the other Services and Special Operations Command's rotary wing aircraft.

FY 1994 Accomplishments:

- Designed and developed the dual spectral advanced helicopter pilotage (AHP) sensor and display prototype subsystem that provides technology risk reduction and technology enhancement efforts in support of Comanche/future night pilotage requirements (4438)
- Determined AI2 configuration which maximizes commonality and meets requirements of aviation, infantry and driver's viewer operational requirements (3611)

FY 1995 Planned Program:

- Demonstrate high bandwidth/resolution standardized advanced dewar assembly (SADA-1) focal plane array and high resolution, helmet mounted image intensified/charge coupled device (CCD) camera with advanced signal processing for Comanche risk reduction. Integrate AHP Phase I sensors and processing for Comanche risk reduction. Integrate AHP Phase I sensors and display into AH-64C Apache aircraft and demonstrate to aviation user (4268)
- Demonstrate AI2 to aviation user and develop infantry version with higher resolution symbology/graphics integrated (2475)
- Investigate technology for low-cost aerial sensors for targeting of tactical ground targets, applicable to manned and unmanned aerial platforms (895)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (161)

FY 1996 Planned Program:

- Develop and integrate a wide FOV (40 x 80 deg) dual spectrum (FLIR & I2) sensor to provide significant reduction in pilot workload (4417)
- Conduct AI2 advanced warfighting demo with the user; provide transition option to program manager (2500)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603710A Night Vision Advanced Technology

- Design and develop aerial scout sensor suite that will provide for non-line of sight targeting, over-the-hill battlefield reconnaissance surveillance and battlefield assessment. Candidate sensors include staring FLIR, moving target indicator (MTI) radar and wide area IR linescanner (2466)

FY 1997 Planned Program:
- Demonstrate wide-FOV night pilotage system-helmet mounted display system and dual spectrum (FLIR and I2) sensors in a single turret (2498)
- Complete evaluation of candidate aerial scout sensors and begin integration on aerial platform (3410)

Project DK87 - Night Vision, Combat Vehicles: This project demonstrates target acquisition sensor technology to meet the stringent fire control requirements of combat vehicles. This sensor technology will provide the range and sensitivity necessary to support the target engagement capabilities inherent in weapon fire control systems of ground vehicles and infrared search and track technology for air defense applications.

FY 1994 Accomplishments:
- Integrated second generation tank sight (SGTS) into an M1 tank and conducted live fire field demonstration with Battle Labs; transitioned technology to Program Executive Officer (PEO) Armaments (2164)
- Conducted technology trade-off determinations and sensor evaluation to determine the optimum electronic integrated sensor suite (EISS) to provide an on-the-move capability for passive, automated wide-area search, acquisition, identification, and ranging with hand-off to air defense weapon platforms. Integrated "hot mock-up" testbed; conducted static data collection (2433)
- Evaluated technology for demonstration of a moving target indicator (MTI) ground radar to provide the tank commander with capability for all-weather search, target acquisition and tracking at extended ranges against moving targets (500)

FY 1995 Planned Program:
- Incorporate results of the EISS test bed experiment and trade-off studies into best technical approach for "on-the-move-suite". Evaluate test bed results (1970)
- Procure MTI radar demonstrator and integrate into a M1 tank testbed in preparation for user/developer test under the Army's advanced vehicles technology demonstration (2000)
- Establish parameters and design an advanced target acquisition suite for future reduced tank crew applications (4558)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (182)

FY 1996 Planned Program:
- Complete EISS data collection and algorithm enhancements, and single band/single aperture trade studies (2841)
- Integrate processor and sensor suite. Demonstrate and baseline the target acquisition sensor suite for performance. Demonstrate MTI millimeter wave (MMW) radar (6544)

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FY 1997 Planned Program:

- Complete EISS integration with platform and conduct limited capability demonstrations and transition to masked target kill (4000)
- Integrate and demonstrate target acquisition sensor suite and processor and radar on surrogate vehicle (8470)

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	34762	33612	37824	36651
Appropriated Value	34762	33177		
Adjustments to Appropriated Value	-1438			
a. SBIR/STTR decrement (-538)				
b. Reprogramming (-900)				
Current President's Budget Submit	33324	33177	37969	37193

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

PROJECT: DK70

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DK70 Night Vision Advanced Technology	20178	16668	19201	18815	12912	18665	17936	16461	Continuing	Continuing

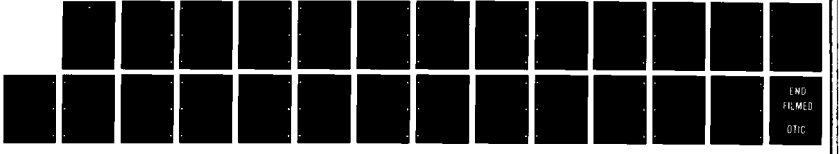
C. **Other Program Funding Summary** See paragraph A for related programs.

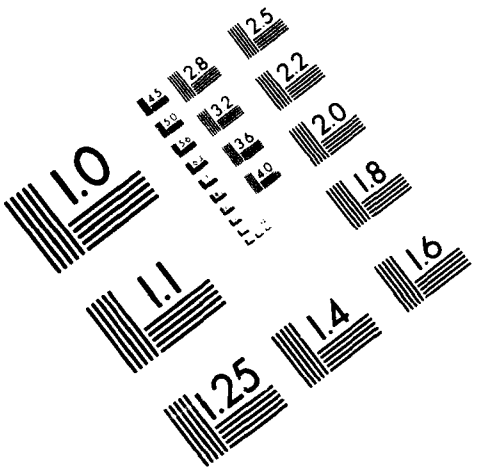
D. **Schedule Profile:**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
MSAT-Air field test and operational demonstration of multi-sensor fusion								X								
Demonstrate Remote Sentry ATD hardware												X				

AD-A206 766 DESCRIPTIVE SUMMARIES OF THE RESEARCH DEVELOPMENT TEST 5/5
AND EVALUATION ARM..(U) ASSISTANT SECRETARY OF THE ARMY
(FINANCIAL MANAGEMENT) WASH.. XA-SAFM

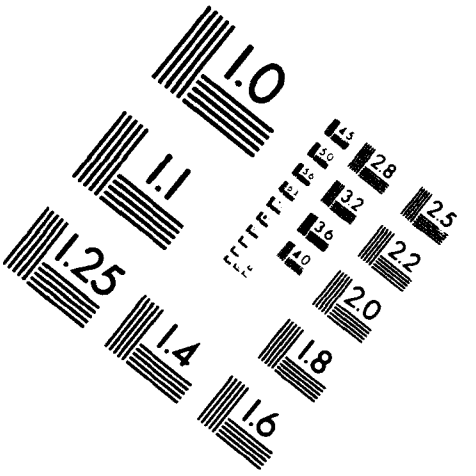
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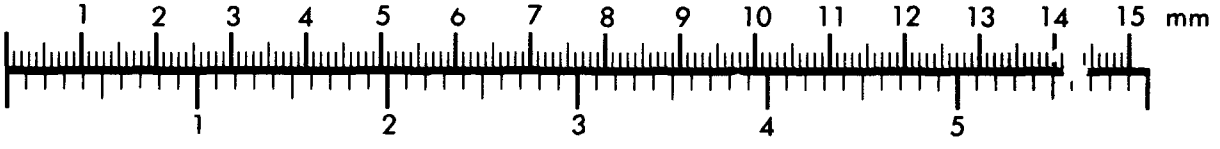




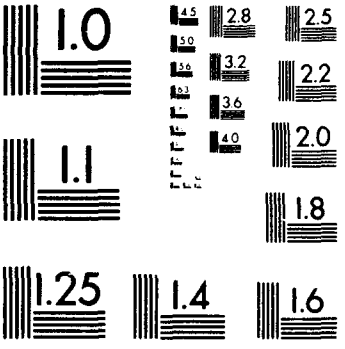
Association for Information and Image Management
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

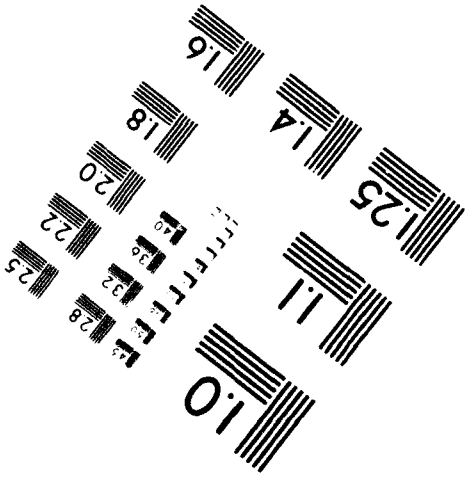


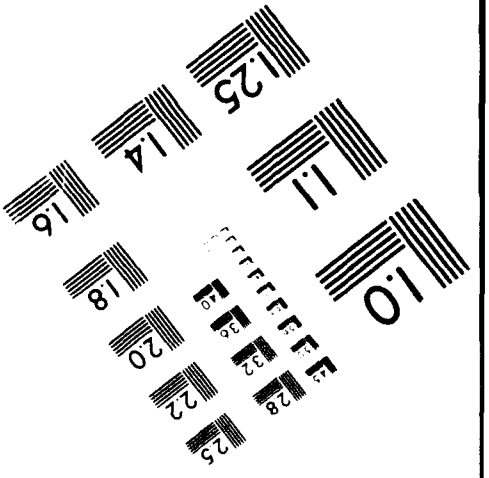
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

PROJECT: DK86

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DK86 Night Vision, Airborne Systems	8049	7799	9383	5908	7778	9858	10492	10975	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conduct AI2 demo with user												X				

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603710A Night Vision Advanced Technology

PROJECT: DK87

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DK87 Night Vision, Combat Vehicles	5097	8710	9385	12470	10854	13439	15487	14965	Continuing	Continuing

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Complete EISS data collection and algorithm enhancements										X						
Integrate and demonstrate Target Acquisition Sensor Suite and processor															X	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603734A Military Engineering Adv Tech

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	2865	12656	12380	13713	3980	4976	5996	6983	Continuing	Continuing
DT08 Combat Engineering Systems	2865	2184	2913	3642	3980	4976	5996	6983	Continuing	Continuing
DT10 Total Distribution Advanced Technology Demonstration	0	10472	9467	10071	0	0	0	0	0	30010

A. **Mission Description and Budget Item Justification :** This program encompasses demonstrations of technologies that provide the capabilities required for the engineer and logistician to successfully execute their missions in support of the force projection Army. Critical deficiencies exist in the Army's ability to rapidly update, maintain, and distribute relevant terrain data, apply physics-based reasoning to planning and executing mobility, countermobility, survivability, and general engineering missions; establishing in-transit visibility of material and supplies; management of logistics distribution and logistics automation. The two demonstration projects in this program element focus on the technologies required to correct these critical deficiencies. Capabilities demonstrated will be applicable to engineer and logistics missions at all echelons within the force structure and during either combat operations or operations other than war. Demonstrations are integral components of Army Advanced Warfighting Experiments, 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 common representation of terrain and consistent predictions or assessments of mobility, countermobility, survivability, and logistics missions in the linkage of C2 systems, models, and simulations being developed by the Army to exploit information technologies. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This program is dedicated to conducting proof of principle field demonstrations and tests of technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.

Project DT08 - Combat Engineering Systems: This project will integrate and demonstrate capabilities to rapidly generate, update and manage digital topographic data in-the-field to support warfighters in cases where Defense Mapping Agency (DMA) data are not available or need to be modified to reflect current intelligence. The topographic information integration prototype (TIIP) will be used to generate digital terrain elevation data (DTED) and orthophotos from imagery and map sources. The orthophotos will be draped over the DTED and can be annotated with appropriate symbology and used as image maps to provide a 3-D view of the battlefield. Terrain update module (TUM) software will be used for dynamic update of standard digital DMA topographic data. The use of multiple TUMs to shorten database generation times will be demonstrated as will the database management software to process data from multiple TUMs. This project will also demonstrate decision support applications for mobility, countermobility and survivability that support multiple battlefield operating systems, including maneuver, command and control, and mobility and survivability. The obstacle planning system and the simplified survivability assessment system will be demonstrated in a brigade level exercise. Available visualization techniques will be used to provide the commander a backdrop to review the plan along with the current situation by draping the plan and other operational overlays on imagery and digital map backgrounds. Automated linkages of the planning system to the virtual environment will be demonstrated in an existing 3-D walk/drive/fly- through environment where man-made features created in a planning cycle become apparent as dynamic environment and terrain (DET) in the virtual rehearsal cycle. Transition targets for the software capabilities that will be integrated and demonstrated under this project include the digital topographic support system

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BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603734A Military Engineering Adv Tech

(DTSS) and the Army battle command system (ABCS). The work is performed by: the Cold Regions Research and Engineering Laboratory, Hanover, NH; the Topographic Engineering Center, Alexandria, VA; and the Waterways Experiment Station, Vicksburg, MS.

FY1994 Accomplishments:

- Conducted demonstrations of capability to update DMA standard topographic data in the field supporting the Commander in Chief, U.S. Army, Europe (CINCUSAREUR). (190)
- Conducted a demonstration of split-based topographic support during Louisiana Maneuvers (LAM) Exercise Northern Lights. (460)
- Finalized Total Distribution Advanced Technology Demonstration (TDATD) test plan and established TDATD testbed by networking strategic, operational and tactical nodes in a distributed interactive simulation (DIS) environment (TDATD is restructured to project DT10 in FY95). (2215)

FY1995 Planned Program:

- Complete integration and documentation of terrain data update software for transition to topographic battalions. (240)
- Integrate database management capabilities with rapid database generation and update capabilities. (510)
- Conduct demonstration of baseline countermobility and survivability battle command capability during Prairie Warrior 95. (1388)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992. (46)

FY1996 Planned Program:

- Demonstrate integrated database generation and update capabilities in support of early entry forces. (600)
- Integrate mobility, countermobility and survivability mission planning modules to support brigade operations. (2093)
- Conduct proof-of-concept demonstrations of common representation of obstacles in live and virtual environments. (220)

FY1997 Planned Program:

- Demonstrate an automated interconnectivity between command and control systems and simulations for common representation of obstacles. (500)
- Conduct objective demonstration of countermobility and survivability mission planning and tracking during Task Force XXI advanced warfighting experiment. (3142)

Project DT10 - Total Distribution Advanced Technology Demonstration (TDATD): Operation Desert Storm showed that the logistics distribution system needed major improvements to increase its efficiency and effectiveness. The TDATD was established to demonstrate potential enhancements in logistics situational awareness and course of action analyses supporting distribution management, in-transit asset visibility and logistics automation and communication. The TDATD will demonstrate automated logistics planning tools, computer simulation and modeling techniques, advanced microelectronics, satellite tracking and communications technology to support an advanced objective logistics capability. These tools will be demonstrated within the context of an integrated, four module situational awareness and analysis system: (1) U.S. based mobilization, deployment and sustainment as it unfolds ("strategic" module); (2) theater level reception and processing of equipment and supplies as they arrive in theater by air and sea ("operational" module); (3) the theater being supported ("tactical" Module); and (4) decision support information ("asset management" module). The work is performed by: the Topographic Engineering Center, Alexandria, VA; the Waterways Experiment Station, Vicksburg, MS; Communications and Electronics

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603734A Military Engineering Adv Tech

Research Development and Engineering Center, Fort Monmouth, NJ, Missile Research Development and Engineering Center, Huntsville, AL; and the Army Research Laboratory, Aberdeen Proving Ground, MD.

FY 1994 Accomplishments: Work conducted under Project DT08 in this PE. The ATD is restructured to Project DT10 in FY 1995

FY 1995 Planned Program:
- Develop and integrate simulation and modeling capabilities into logistics course of action (COA) automated systems. (3993)
- Develop Logistics Anchor Desk (LAD) connectivity to real logistics data sources (Total asset Visibility (TAV) and the Global Transportation Network (GTN)) (200)
- Develop infrastructure and 3-D terrain visualization capabilities and data for logistics automated systems. (1700)
- Develop interfaces from COA systems for incorporation into the Combat Service Support Control System (CSSCS) and the Army Global Command and Control System (AGCCS) architecture. (1950)
- Demonstrate enhanced logistics automation capabilities in Prairie Warrior 95, and other exercises, with warfighting CINC (Commander-in-Chief) leave behinds, using LAD. (2410)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Reauthorization Act of 1992 (219)

FY 1996 Planned Program:
- Develop expanded LAD connectivity to real logistics data sources (the Standard Army Management Information Systems (STAMIS) and additional classes of supply. (350)
- Develop and integrate enhanced infrastructure and terrain visualization capabilities and data such as engineer data and road/port data. (1370)
- Develop simulation capabilities for additional COA analysis to include machine learning and knowledge discovery and expanded data visualization in the LAD. (3580)
- Develop interfaces into the CSSCS/AGCCS architecture in a client-server based relationship while providing technology options for these systems. (2280)
- Develop links and provide the warfighting commanders with enhanced leave-behind logistics automation capabilities through participation in AWE's such as Prairie Warrior and Unified Endeavor. (1887)

FY 1997 Planned Program:
- Complete development of expanded LAD connectivity to real logistics data sources by incorporating automated data management and other data integrity utilities. (551)
- Develop enhanced LAD COA and logistics automation and infrastructure assessment capabilities utilizing sensitivity analysis and end-to-end COA analysis. (4630)
- Transition advanced LAD capabilities into the AGCCS/CSSCS architecture to provide these systems improved logistics capabilities. (2670)
- Insert enhanced LAD COA technology into leave-behind logistics automation capabilities that are fully integrated into the Global Command and Control System (GCCS) and the Army Command and Control systems for the warfighting CINCs. (850)
- Demonstrate LAD capabilities integrated within the common architecture in Prairie Warrior and Task Force XXI. (1370)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603734A Military Engineering Adv Tech

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	2910	12829	18113	8504
Appropriated Value	2910	12656		
Adjustments to Appropriated Value	-45			
SBIR/STTR decrement (-45)				
Current President's Budget Submit	2865	12656	12380	13713

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603734A Military Engineering Adv Tech

PROJECT: DT08

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DT08 Combat Engineering Systems	2865	2184	2913	3642	3980	4976	5996	6963	Continuing	Continuing

C. **Other Program Funding Summary** N/A.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Demonstrate update capability of DMA topographic data for CINCUSAREUR				X*												
Demonstrate split-based topographic support for LAM Northern Lights				X*												
Finalize TDATD (DT10) test plan				X*												
Demonstrate baseline mission planning and simulation								X								
Demonstrate database generation and update capabilities for early entry												X				
Demonstrate mission planning and simulation on network and field exercises																X

*Denotes completed effort

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603734A Military Engineering Adv Tech

PROJECT: DT10

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DT10 Total Distribution Advanced Technology Demonstration	0	10472	9467	10071	0	0	0	0	0	30010

C. **Other Program Funding Summary** N/A.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
First Log Demonstration								X								
Participate in LAM-95 exercise								X								
Participate in TDATD field training exercise #1								X								
Participate in TDATD field training exercise #2											X					
Participate in LAM-96 exercise												X				
Demonstrate baseline logistics awareness/course of action analysis capability															X	
Participate in TDATD field trial															X	
Participate in LAM-97 exercise																X

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

DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603759A Chem Bio Def And Smoke Adv Tech

PROJECT: DE83

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DE83 Chemical Biological Defense Systems Adv Tech	2591	193	0	0	0	0	0	0	0	2787

A. Mission Description and Budget Item Justification: This program element funds demonstrations of technologies and materiel in support of deterrence and defense against chemical and biological warfare as well as for equipment defeating munitions. Army is the Department of Defense (DoD) Executive Agent for Chemical Warfare (CW) and Chemical and Biological Defense (CBD) research. This program element provides technologies critical to counterproliferation. These efforts comprise risk-reducing demonstrations conducted in an operational environment with active user and developer participation. These demonstrations integrate diverse technologies to improve DoD CW deterrence and CBD. Upon review of the requirements and priorities, the original Flame/Incendiary Munitions demonstration (FY95-97) was restructured to support the Multi-Purpose Individual Munition. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. Efforts under this PE transition and provide risk reduction for Demonstration/Validation, Engineering Development and Operational Development programs supported by PE 0603806A/0603884BP, PE 0604806A/0604384BP and PE 0605384BP. This program is dedicated to conducting proof of principal field demonstrations and tests of system-specific technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3. Public Law 103-160 realigns funding for chemical/biological defense from the Services and consolidates it at the OSD level beginning in FY 1996 (PE 0603384BP).

Project DE83 - Chemical Biological Defense Systems Advanced Technology: This project demonstrates technology advancements in the areas of agent detection and identification, decontamination, individual and collective protection, and smoke/novel effects munitions which will speed maturing of advanced technologies to reduce risk in system-oriented Demonstration and Validation (Dem/Val).

FY 1994 Accomplishments:

- Fabricated Respo 21 prototypes and conducted demonstration. Supported 21st Century Land Warrior/special applications (1031)
- Fabricated fixed site collective protection prototypes and conducted demonstration. Transitioned to programs such as deployable medical system (DEPMEDS) and Air Force Shelter (835)
- Optimized, characterized and demonstrated sorbent decontamination (725)

FY 1995 Planned Program:

- Support the Multi-Purpose Individual Munition (MPIM) effort by reviewing and providing design guidance for the flame payload approaches (192)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (4)

FY1996 Planned Program: Funded under DoD PE 0603384BP

FY1997 Planned Program: Funded under DoD PE 0603384BP

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603759A Chem Bio Def And Smoke Adv Tech

B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	2631	198	3998	6019
Appropriated Value	2631	196		
Adjustments to Appropriated Value	-40			
SBIR/STTR decrement (-40)				
Current President's Budget Submit	2591	196	0	0

C. Other Program Funding Summary: See para A.

D. Schedule Profile:

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Fabricate/Test Respo 21				X*												
Fabricate/Test Collective Protection				X*												
Optimize/Test Sorbent decon				X*												
Review MPIM Design							X									

* Denotes a completed effort

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603771A Army Industrial Preparedness Mfg Tech

PROJECT: DE20

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
DE20 Mfg Science and Technology	0	35335	17776	17284	17687	17913	18789	19594	Continuing	Continuing

A. **Mission Description and Budget Item Justification:** Supports the Army Manufacturing Science and Technology Program (MS&T). The goals of the program include: development of advanced manufacturing processes, equipment and systems, enhanced quality and reduced cost of Army materiel, and transfer of this technology to the industrial base. In the current environment, the MS&T program is even more important than in past years because of the large decline in weapon system production investments where much manufacturing technology was accomplished within individual production programs. Beginning in FY90, the program was restructured to focus resources on a smaller number of technology thrust areas and leverage Army resources with private and other government efforts. The technology areas supported by the program include electronics manufacturing, metals fabrication and processing, composites processing, manufacturing systems, and advanced industrial practices. The technologies selected have the potential for high payoff across the spectrum of Army weapons systems as well as significant impact on national manufacturing issues and the U.S. industrial base. The Army MS&T Strategic Plan definitizes projected requirements, objectives and technical approaches. This project was realigned from Program Element 0708045A.

Project DE20 - Manufacturing Science and Technology: Resources for this project support programs in the development and implementation of advanced technologies for the production of Army weapons systems. Work in this project includes electronics manufacturing, composites fabrication and processing, energetic materials processing, metals fabrication and processing, manufacturing systems, chemical/biological defense materials and processes, and optics/electro-optics manufacturing. This project provides assistance to Army program managers in helping to achieve producible and affordable weapons systems.

FY 1994 Accomplishments: Project funded under PE 0708045A. Program restructured to PE 0603771A in FY95.

FY 1995 Planned Program:

Electronics Processing and Manufacturing.

- Electronics Manufacturing - Complete development of the Sequential Electrochemical Reduction Analysis process for soldering and conduct technology transfer to industry; complete process and tool development for laser welding microcircuit devices for hermetic sealing of missile guidance and control electronic packages; and continue educational partnerships to advance small business and minority electronics manufacturing technology (1537).
- Electro-Optics - Initiate, develop and validate selected processes for components of the Compact Class Focal Plane Array Dewar Module and implement into the Low Rate Initial Production (LRIP) of Thermal Weapons Sights (TWS); establish flexible manufacturing line for Staring Class FPA (Missile Seeker) Dewar, produce test dewars for analysis and qualification, document production processes, and document pilot production line, test equipment design and operation; baseline industry manufacturing practices, develop trade study and begin process development for components of the High and Mid to High FPA Cooler; begin definition and evaluation of the fiber optic cable assembly termination cell and assessment of current manufacturing capabilities (1615)
- Optics - Apply process studies and pilot production runs to modify the Opticam SX CNC spherical lens grinding machine and fabricate and test subassemblies; integrate improved tool design prototypes into Opticam equipment and test performance and vibration reduction; design, build and acceptance test prototype second

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1995
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603771A Army Industrial Preparedness Mfg Tech

generation Opticam machine for prisms; evaluate effects of active vibration cancellation (AVC) techniques on process parameters and evaluate any required adjustments; integrate the Opticam PM machine into the Opticim system, and modify and expand related CAD/CAM programs and the database to accommodate the new system; establish system performance definition and requirements, and prototype configuration, specifications and manufacturing plan for video inspection and non-contact metrology of plano and flat optical surfaces; investigate adaptability of advanced optical manufacturing technology and processes beyond the basic Opticam capabilities and select initial areas for pilot implementation; develop prototype configuration, specifications and manufacturing plan for Opticam AM (Aspheric Module), begin subassembly construction and testing (4733 - includes a Congressional increase).

- Missile Seekers - Demonstrate manufacturing feasibility for 3D optically connected image processor and staked UV and IR sensors for potential dual-band application; design EMI grid mask imaging process and design and fabricate conformal photomask for thin film shielding of seeker domes; conduct Longbow Integrated Product & Process Development (IPPD) Transceiver Risk Assessment and establish bench marking metrics to meet Army mandated and approved cost reduction goals (3600).
- Advanced Non-Metallic Batteries - Adapt high volume production techniques/equipment used in production of lithium sulfur dioxide batteries to the maximum extent, investigate industrial practices used in commercial production of lithium ion and other batteries, and expand the use of commercial foil coating processes using a flexible manufacturing philosophy to accommodate various cell sizes (2885-includes a Congressional increase).

Composites Processing and Fabrication.

- Composites Fabrication - Complete Resin Transfer Molding (RTM) validation trials for Comanche keel beam, initiate baseline spar redesign for fiber-placed rotor blades; complete review and investigation of toughened epoxy adhesive systems, and validate procedures in microfactory/production line environment; initiate maximum variable flexibility determination for thermoplastic composites, bring microfactory site on-line (1175).

Metals Processing and Manufacturing.

- Metals and Processing - Complete process development for powder metallurgy for turbine engine spacer and validate improved process for turbine disk; continue process development for sputtering deposition of refractory metals; complete process specifications for electro-chemical machining of small caliber gun barrels; complete casting pours of trial segments and validate and refine casting procedures for Cast Beryllium Aluminum Components (1565).
- Instrumented Factory for Gears (INFAC) - Continue development of improved heat treatment processing and prediction and control of heat treatment distortion, initiate efforts for improved grinding, automated deburring and netshape forming of gears (8220 - This program is a Congressional add).
- Manufacturing Test Technology - Complete development of prototype laser based inspection methodology for detection of manufacturing flaws in multi layer printed circuit boards; develop prototype automated test station for nondestructive testing of large area uncooled focal plane arrays; develop prototype multiaxis vibration tester; design and construct prototype sorption and permeation test apparatus for rapid testing of chemical protection materials; and assemble test apparatus and perform integration and testing for Non-Contact Measurement of Propulsion System Components (1036).
- Chemical/Biological Defense - Complete anti-ricin antibody process development; complete scale-up of thermostable unease process to 30-liter capacity; complete bench-scale (5-liter) process scale-up for bioremediation materials; identify and prove-out substitute for Freon 12 for use in filter leak testing (1250).
- Explosives and Propellants -Complete continuous processing system upgrade for live processing demonstration; initiate hydroxylammonium nitrate (HAN) process technology demonstration; initiate modeling for computer simulation analysis procedures for munitions load, assemble, pack (LAP) process to enhance low volume production productivity (1960).

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	PROJECT DE20

Manufacturing Systems

- Advanced Integrated Manufacturing Systems - Develop missile integrated product development database and product/process models; complete Quick Turnaround Cell system software; fabricate and test selected items using laser forming process for titanium structures without molds; develop rule-oriented software for integration and management of manufacturing information; and develop and evaluate alternate designs for a vibratory rate microgyroscope for low-cost solutions to multi-position sensing problems (2050).
- Remanufacturing and Reclamation - Develop advanced technologies and processes applicable to disassembly, repair and cleaning for the AH-64 Apache and Multiple Launch Rocket Systems (MLRS); develop a supercritical CO2 cleaning process for optical parts/subassemblies; identify and begin evaluation of integration technologies for the Battlefield Manufacturing Center (625).
- Sensors in Manufacturing - Fabricate components, conduct processing trials and refine criteria for sensor data for "Smartweave" In-Situ Sensors for Composite Structures; Complete development of Generalized Adaptive Image Inspection Analyzer; develop prototype nondestructive detector array tester; develop rule bases to interpret printed wiring assembly lithography patterns and associated inspection criteria; develop plasma formation parameters for low cost non-contact laser-based testing of printed circuit boards and electronic modules (937).
- Soldier Support - Develop technology and processes required for troop uniform manufacture and advanced combat rations (440).

Advanced Industrial Practices

- Longbow Integrated Composites Manufacturing - Establish integrated product team, conduct analysis of current business practices and policies, define metrics to measure benefit of changes, develop selection criteria for efficient business practices and policies, and initiate efficient business practices and policies and improved process technologies(1000).

- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovative Research Program Reauthorization Act of 1992 (707).

FY 1996 Planned Program:

Electronics Processing and Manufacturing.

- Electronics Manufacturing -Evaluate and select design tool platform, and complete direct write technique for Rapid Turn-Around Printed Wiring Board (PWB) Cell; develop a heat dissipation technique for testing high power electronic wafers, and design and model a test chuck for high power testing; continue educational partnerships to advance small business and minority electronics manufacturing technology (750).
- Electro-Optics - Complete process development for Compact Class FPA Dewar Module, validate and implement automated alignment and bonding process into TWS LRIP, prepare final reports, and conduct industry review; prepare final reports for Staring Class FPA (Missile Seeker) and conduct final industry demonstration for technology transfer; continue development of manufacturing processes for components of High and Mid to High FPA Cooler, begin implementation and validation processes on the manufacturing line; develop tooling and fabricate prototype required to produce a flexible fiber optic cable assembly system (1350).
- Optics - Complete modifications, perform acceptance tests, conduct pilot production run and conduct industry demonstration for the Opticam SX machine; document optical fabrication tool design and demonstrate to industry; incorporate process study results into process parameter database; document Opticam PM and SX machine interface and software application customization files and transfer to industrial users/developers; analyze several proposed alternatives for non-contact inspection in

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the Opticam environment; continue to develop selected areas of advanced optical manufacturing technology; complete construction, testing and evaluation of the Opticam/PL machine, conduct industrial demo and pilot runs of funded plan optics; assemble prototype Opticam AM machine (1500).

- Missile Seekers - Develop manufacturing processes for a 2-3 layer optically integrated image processor and a 64 x 64 UV/IR stacked array; develop IPPD manufacturing methodology for millimeter wave transceivers (2600).

Composites Processing and Fabrication.

- Composites Fabrication - Complete Comanche baseline spar redesign for fiber-placed rotor blades; select test variables and initiate test procedures on metallic substrates for adhesive-bonded structures; continue maximum variable flexibility determination for thermoplastic composites (1000).
- Composite Armored Vehicle (CAV) - Evaluate application of composite design tools to Land Combat Vehicles, including large/thick composite structures (400).

Metals Processing and Fabrication.

- Metals and Processing - Develop sputtering process specification for deposition of refractory metals; initiate and complete tooling design for electro-chemical machining of small caliber gun barrels, conduct initial ECM trial, and manufacture test barrel blanks; initiate and complete demonstration of modeling and simulation for beryllium-aluminum casting process; develop process specification and tooling for fabrication of turbine airfoils and initiate fabrication trials (1370).
- Instrumented Factory for Gears (INFAC) - Initiate validation of computer model to predict and control heat treatment distortion; fabricate prototype system to automate gear deburring (1000).
- Manufacturing Test Technology - Complete prototype automated test station for uncooled staring FPA's; complete sensor suite and pattern matching algorithms for Non-Intrusive, In-Field Diesel Engine Diagnostic System; install blade inspector system for Non-Contact Measurement of Propulsion System Components and conduct demonstration test; construct preliminary prototype three-axis vibration tester; complete testing and debugging of prototype sorption and permeation test apparatus; and prepare procurement package for prototype Automated Residual Stress Analyzing Machine (ASRAM) (780).
- Chemical/Biological Defense - Complete one anti-pathogen antibody process, specifications and demonstration; complete scale-up of thermostable unease process to 150-liter capacity, specifications and demonstration; and complete pilot-scale (150-liter and 1,500-liter) process scale-ups for bioremediation materials (900).
- Explosives and Propellants - Initiate live demo of continuous processing system; complete HAN process technology demo; initiate triethanolammonium nitrate (TEAN) process optimization; develop and test alternative methods of computer simulation analysis procedures for munitions Load Assembled Pack (LAP) process to enhance productivity (1775).

Manufacturing Systems.

- Advanced Integrated Manufacturing Systems - Conduct field tests of parts produced in Laser Forming Titanium Structures Without Molds; simulate injection molding of composite components for Composite Armored Vehicle, demonstrate virtual environment, and deploy Smartweave sensors to observe resin flow; develop preliminary enterprise information architecture that enables concurrent operation of multiple functional systems; develop missile/munitions IPPD database desktop tools; and investigate and identify rapid prototyping techniques, and select/procure equipment and materials for developing prototypes of complex propulsion components (1585).

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	PROJECT DE20

- Remanufacturing and Reclamation - Optimize the remanufacturing process for servovalve assemblies and conduct Tri-Service application studies; complete prove-out of the supercritical CO2 cleaning process and specifications for optical parts/subassemblies; develop alternative to chromium plating process using High Velocity Oxygen Fuel (HVOF) techniques; continue investigation of integration technologies for the Battlefield Manufacturing Center (500).
- Sensors in Manufacturing - Conduct process optimization trials for Smartweave In-Situ Sensors; develop hardware, software and prototype to inspect additional flaw classes for Nondestructive Visualization Using 3D/X-ray Laminography; develop specifications for a non-contact passive electrical component tester; conduct validation testing of prototype nondestructive detector array tester (1391).
- Soldier Systems - Continue to develop manufacturing procedures and processes and conduct testing required for troop uniform manufacture, next generation body armor and advanced troop combat rations (375).

Advanced Industrial Practices.

- Longbow Integrated Composites Manufacturing - Continue demonstration of business practices and improved process technologies through fabrication of selected components (500).

FY 1997 Planned Program:

Electronics Processing and Manufacturing.

- Electronics Manufacturing - Test various substrate formats and begin production hardware design for Rapid Turn-Around PWB Cell; catalog existing commercial materials and analyze suitability for military applications for Advanced Conductive Adhesives; determine power output, dwell time and pulse cycle for various component configurations for Laser Welding for Electronics; develop prototype high power test chuck and evaluate heat dissipation techniques using missile seeker electronics hardware; continue educational partnerships to advance small business and minority manufacturing technology (750).
- Electro-Optics - Build and test High and Mid to High FPA Coolers for demonstration and validation of developed processes; continue tooling development and prototype fabrication to produce a flexible fiber optic cable assembly system; begin investigation of Manufacturing Properties of Advanced Electro-Optics Materials; develop package design and fixtures, and design material handling equipment for Laser Diode Arrays (2035).
- Optics - Complete data package for prototype inspection hardware for Advanced Inspection Techniques for Opticam; continue to optimize selected high potential candidate Advanced Optical Technologies and prototype production equipment; begin interface operation with Opticim PC-based CIM network for CAM machine for aspheric optics (1500).
- Missile Seekers - Demonstrate manufacturing techniques for a 3-5 layer image processor in TACAWS Auto Target Recognition System and a 128 x 128 UV/IR stacked array for potential use in Stinger Block II; continue to develop IPPD manufacturing methods for millimeter wave transceivers by integrating and implementing newly developed or improved manufacturing processes and techniques into new or existing work cells to form a pilot production line (2650).

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Composites Processing and Fabrication.

- Composites Fabrication - Complete Comanche fiber-placed rotor blade spar mandrel design, and fabrication of mandrel and spar; continue testing on metallic substrates and initiate test procedures on composite matrix materials; continue maximum variability flexibility determination for composites and begin qualification testing of microfactory facility (925).
- Composite Armored Vehicle - Develop fabrication and assembly process models to detail sequence of activities in manufacturing composite hull/armor components (200).

Metals Processing and Manufacturing.

- Metals and Processing - Refine tooling design, conduct trials, perform test and inspection and complete final technical report for electro-chemical machining of small caliber gun barrels; develop and demonstrate process for using beryllium aluminum recycled material in production of precision casting, complete government/industry briefing, and complete final technical report; conduct pilot production demonstration of fabrication of turbine airfoils, and initiate process evaluation and component testing (1070).
- Instrumented Factory for Gears (INFAC) - Complete validation of computer model; demonstrate automated deburring process; and continue development of improved grinding and net shape forming (800).
- Manufacturing Test Technology - Develop prototype engine condition analyzer for Non-Intrusive In-Field Diesel Engine Diagnostic Systems; complete construction of prototype low-cost 3-axis vibration analyzer; develop standardized shells with known residual stress levels for Automated Residual Stress Analyzing Machine (ARSAM); develop consulting contract and determine prototype design characteristics for Calibration/Simulation Under Temperature Variations; prepare statement of work, award contract, and investigate available technology and hardware for Production Line Testing of Ultralightweight Camouflage Net System (ULCANS) (675).
- Chemical/Biological Defense - Conduct 1,500 - liter process demonstration for bioremediation materials, complete final project technical report, and prepare process specifications (900).
- Explosives and Propellants - Complete live demo of continuous processing system; complete TEAN process optimization; initiate DNT/TNT process demonstration; complete modeling and issue final report detailing productivity improvements of Computer Simulation Analysis for Munitions LAP Process (1800).

Manufacturing Systems.

- Advanced Integrated Manufacturing Systems - Complete enterprise information architecture that enables concurrent operation of multiple functional systems for Integration and Management of Manufacturing Information; demonstrate process for more sophisticated shapes and structures for Laser Forming of Titanium Structures Without Molds, and transition to industry suppliers; develop missile/munitions virtual factories; and assess effectiveness of Smartweave grid in health monitoring and damage assessment, and rapid design protocol in Design Tools for Resin Transfer Molding of Thick Composite Structures (1500).
- Remanufacturing and Reclamation - Optimize process and conduct final prove-out of High Velocity Oxygen Fuel Thermal Spray System; continue evaluation and implementation of integrating technologies for the Battlefield Manufacturing Center (325).
- Sensors in Manufacturing - Complete testing of embedded Smartweave grid, conduct ballistic impact damage testing/validation, and develop expert system; develop inspection algorithms and flaw recognition expert system for Nondestructive Visualization Using 3D/Xray Laminography; develop prototype of a non-contact electrical component tester; complete development of prototype nondestructive detector array tester; begin evaluation of current technologies and determine and

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	PROJECT DE20

develop enabling technologies for reverse engineering multilayer PWB's; develop preliminary details of surface data acquisition system in High Resolution Surface Contour Measurement (1399).

- Soldier Systems - Continue to develop manufacturing technology, processes, testing and implementation for troop uniform manufacture, next generation body armor and advanced troop combat rations (255).

Advanced Industrial Practices.

- Longbow Integrated Composites Manufacturing - Complete demonstration in pilot production environment; define benefits based on established metrics; develop implementation for transition of demonstrated changes; conduct government/industry end of project briefings; initiate and complete final technical report (500).

B. Program Change Summary	FY 1994	FY 1995	FY 1996	FY 1996
Previous President's Budget	0	0	0	0
Appropriated Value	0	35335	0	0
Adjustments to Appropriated Value	0	0	0	0
Current President's Budget	0	35335	17776	17284

Change Summary Explanation:

Funding: Program funded under PE 0708045A in FY94. Program restructured to PE 0603771A in FY95. The Congressional decision to transfer the Army's portion of the Industrial Preparedness and Manufacturing Technology Program from RDT&E, Defense to RDT&E, Army is reflected in the funding adjustment for FY96 and FY97.

Schedule: Not applicable.

Technical: Not applicable.

C. Other Program Funding Summary: There are no other Army RDT&E or other Appropriation efforts for the Army MS&T program. Air Force, Navy and DLA have similar programs. The Army carries out other industrial preparedness and productivity activities such as Production Base Support that are funded with procurement appropriations.

D. Schedule Profile: Efforts in this project represent continuing advanced manufacturing process development and improvement, therefore no milestone events are provided.

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DATE: February 1995

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603772A Adv Tac Computer Science And Tech

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	27928	34224	33989	29767	23924	24003	24980	22799	Continuing	Continuing
D101 Tactical Automation	13427	19959	23723	21422	16415	18031	17986	16314	Continuing	Continuing
D243 Sensors and Signal Processing	8604	6092	3290	996	3981	5972	6994	6485	Continuing	Continuing
D281 Ground Combat Identification Demonstration	5897	8173	6976	7349	3528	0	0	0	0	31923

A. Mission Description and Budget Item Justification: This program element supports projects that provide advanced computer science and technology solutions to Command and Control (C2), data fusion and combat identification problems. Specifically, this program addresses solutions to integration of the battlefield, synchronization of combined arms forces, synchronization of joint forces, C2 on the move, fusion of intelligence data from airborne and spacebased sensors, integrated situation awareness (SA), battlefield combat identification (CI), and point of engagement identification (ID) approaches to reduce fratricide for ground forces. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. It is related to and fully coordinated with efforts in PE 0602783A (Computer & Software Technology), PE 0602782A (Command, Control & Communications Technology), PE 0603006A (Command, Control & Communications Advanced Technology), PE 0602709A (Night Vision Technology), PE 0603710A (Night Vision Advanced Technology), and PE 0602120A (Electronic Surveillance and Fuzing Technology) in accordance with the ongoing Reliance joint planning process. Work is performed primarily by the U.S. Army Communications-Electronics Research, Development and Engineering Center (CERDEC), Command/Control and Systems Integration Directorate (C2SID), Ft Monmouth, NJ, Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA and Intelligence Electronic Warfare Directorate (IEWD), Vint Hill Farms Station, Warrenton, VA. Project D281 is managed by Project Manager, Combat Identification, Alexandria, VA and Fort Monmouth, NJ. This program is dedicated to conducting field demonstrations and tests of technologies to meet specific military needs and is therefore properly placed in Budget Activity 3.

Project D101 - Tactical Automation: This is the Army's major science and technology program to provide the architecture and products to implement the digitized battlefield which is essential to winning the "Information War". It develops advanced computer science and technology for solutions of Army-unique command and control deficiencies in the area of combined arms operations. Specifically, this project addresses solutions for lower echelon digital information transfer and display for horizontal integration of the battlefield, synchronization of Combined and Joint Forces, command and control (C2) on the move, integrated situation awareness, command and control for light force insertion and platform C2 down to the individual soldier. Key technologies utilized include: expert system decision support technology, database architecture development, data compression, man-machine interfacing, information filtering, advanced information display technology, digital terrain display and manipulation and automated navigation/geopositioning. Major program goals include improved force synchronization and fratricide reduction through the development and display of a common battlefield view. The common battlefield view will be created through the development and implementation of a lower echelon database architecture in the combined arms command and control (CAC2) advanced technology demonstration. Joint developer/user warfighting demonstrations will be conducted in conjunction with the Mounted, Dismounted, and Battle Command Battle Labs. Products will be transitioned to PEOs (Command and Control Systems (CCS), Aviation,

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Armored Systems Modernization (ASM), etc.) for integration within their systems and subsequent fielding. Support for the command and control portion of the generation (Gen) II soldier technology demonstration, which is part of the 21st century land warrior (21 CLW) program is also included.

FY 1994 Accomplishments:

- Developed a digital database architecture for brigade and below (7744)
- Completed Division-and-above decision aids (950)
- Established an R&D and user digital integration lab to simulate key functions necessary to demonstrate horizontal force integration (723)
- Developed, modeled and simulated architecture and platforms for national training exercise Desert Hammer 6 in conjunction with PEO CCS, PEO Aviation, PEO ASM and the Mounted Battlespace Battle Lab (3500)
- With the user, completed an operational requirements analysis for the Rapid Force Projection capability (510)

FY 1995 Planned Program:

- Use distributed interactive simulation facilities at Ft. Knox and Ft. Rucker to validate and refine user requirements, system architecture, doctrine and soldier machine interface for lower echelon digital information transfer and display (4917)
- Initiate command and control technology demonstration for the Rapid Force Projection Initiative (RFPI) demonstration (2000)
- Conduct digital brigade command post exercise simulation at Fort Knox Battle Laboratory (3285)
- Develop baseline lower echelon data-base/communication design and evaluate C2 with distributed digital integration laboratory (4597)
- Develop soldier platform C2 system architecture (3595)
- Demonstrate initial decision support package for battalion and below force synchronization (1162)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (403)

FY 1996 Planned Program:

- Complete development of decision aid software for target solution, threat prioritization and weapons allocation for the light forces (2000)
- Complete joint Combined Arms Command and Control (CAC2)/Combat Identification (ID) demonstration in conjunction with the Mounted Battle Laboratory and demonstrate a brigade digital force (15686)
- Begin Battlespace Management effort to extend the CAC2 system architecture to Joint/Multi-National forces and extend the CAC2 database architecture to the complete data element set (1000)
- Complete soldier C2 prototyping and initial test; initiate fabrication for Generation (Gen) II soldier advanced technology demonstration (ATD) (5037)

FY 1997 Planned Program:

- Demonstrate initial Joint digital battlefield simulation linking Army, Navy and Air Force C2 models (10407)
- Demonstrate RFPI light force command, control, communications and intelligence (C3I) architecture simulation in conjunction with the Dismounted and Early Entry Battle Labs (4000)

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- Complete soldier C2 fabrication and engineering tests for Gen II ATD (7015)

Project D243 - Sensors and Signal Processing: This project provides for advanced development of new radar and signal processing concepts including bistatic radar and develops technology options for the common ground station to support ground station Engineering and Manufacturing Development planned by Program Manager Joint Stars in FY 1996. The Common Ground Station (CGS) technology demonstration is focused on the intelligence requirements of the Brigade commander for near-real-time data, but will provide technology options for receiving, processing and displaying multi-spectral intelligence information and dissemination of intelligence products to the maneuver, fire support or intelligence mission areas. The Bistatic Radar for Weapons Location (BRWL) technology demonstration provides critical sensor and signal processing technology for real-time, all-weather, automatic detection, classification and identification of fixed or moving high-priority targets for the commander and technology for survivable weapon location radar concepts.

FY 1994 Accomplishments:
- Integrated Bistatic Radar for Weapons Location (BRWL) control software and transmitter/receiver components and subsystems. Performed system integration testing and simulation. Integrated system onto mobile platforms and initiated field data collection experiments (2982)
- Conducted CGS advanced antenna proof-of-concept stationary demonstration in conjunction with HQ-TRADOC-coordinated operational system concept (3510)
- Conducted laboratory demonstration of multimedia distributed data base for CGS applications (2112)

FY 1995 Planned Program:
- Conduct data collection and live fire test of BRWL in field environment. Complete software development and integration (4014)
- Integrate sensors to airborne test platforms to demonstrate multisensor air-to-ground targeting technology applicable for low-cost aerial platforms, including unmanned aerial vehicles (51)
- Conduct CGS brigade proof-of-concept demonstration in conjunction with TRADOC (1900)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (127)

FY 1996 Planned Program:
- Complete demonstrations of BRWL in Advanced Warfighting Experiments with Depth and Simultaneous Attack Battle Laboratory to provide technology to PEO Intelligence and Electronic Warfare (IEW) for the Firefinder pre-planned product improvement (P3I) in FY97 (3290)

FY 1997 Planned Program:
- Complete analysis of multisensor mission equipment interface requirements, select testbed aircraft, and define modification requirements (996)

Project D281 - Ground Combat Identification Demonstrations: The objective of this project is to select, develop, and demonstrate techniques that minimize fratricide and increase combat effectiveness during Ground-to-Ground and Air-to-Ground engagements, and to demonstrate integration of advanced target ID and situational awareness (SA) capabilities into the Digitized, Joint battlefield environment and architecture. Selection of candidate approaches for field demonstration are made based on

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results of supporting constructive and virtual simulations and architecture investigations for the combined arms battlefield. The Army's Task Force XXI Digitized Brigade Exercise in early FY 97 will include operational demonstration and experimentation with a large variety of new Battlefield Digitization concepts and technologies including combat identification (CI). The battlefield combat identification technology effort will explore technology options to add enhanced SA capability at platoon level with interface to the digital command and control system to the existing developmental battlefield combat identification system (BCIS). Operational and technical information derived from field experiments and demonstrations will support specification of follow-on Engineering and Manufacturing Development (EMD) of CI equipment.

FY 1994 Accomplishments:

- Completed initial performance modeling of alternative CI system concepts (1900)
- Completed construction of millimeter wave hardware/software CI testbed (2000)
- Defined architecture and initiated software design for situational awareness (SA) extensions compatible with existing developmental BCIS (1197)
- Completed initial architectural studies for air-to-ground CI (800)

FY 1995 Planned Program:

- Complete modifications to the millimeter wave hardware/software testbed and continue experimentation/analytical investigations in support of advanced target ID capabilities and SA applicable to future BCIS enhancements (2600)
- Complete development of digital data link capability for prototype enhancements to BCIS capability and support integration with digital command control and communications (C3) system for ground vehicle application, and support initial field experimentation with the Mounted Battlespace Battle Lab (1300)
- Complete construction of prototype Joint Air-to-Ground CI alternatives for both rotary/fixed wing applications and support initial field experiments with the Army's Mounted Battlespace Battle Lab and other service user representatives (4112)
- Funds will be reprogrammed for SBIR/STTR programs in accordance with the Small Business Innovation Research Program Reauthorization Act of 1992 (161)

FY 1996 Planned Program:

- Complete tradeoff experiments and analyses for technology options to improve the core target ID capability of BCIS (1500)
- Analyze experimental performance of digital data link for prototype enhancement to BCIS capability and complete software design modifications and integration with digital C3 system in preparation for Task Force XXI exercise (2500)
- Complete initial field experiments with prototype Joint Air-to-Ground CI alternatives, select, and complete development of technologies to be demonstrated in Task Force XXI (2976)

FY 1997 Planned Program:

- Complete user training on Air-to-Ground CI equipment, support Task Force XXI field exercise, and assist in data analysis (6349)
- Complete integration of SA into tank sight and integration with digital data link in preparation for transitioning technology into EMD (750)
- Initiate design studies for technology options supporting BCIS capability for the dismounted soldier (250)

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B. Program Change Summary

	FY 1994	FY 1995	FY 1996	FY 1997
Previous President's Budget	26438	34995	34150	31931
Appropriated Value	26438	34224		
Adjustments to Appropriated Value	1490			
a. SBIR/STTR decrement (-410)				
b. Reprogramming (1900)				
Current President's Budget Submit	27928	34224	33989	29767

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PROJECT: D101

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D101 Tactical Automation	13427	19959	23723	21422	16415	18031	17986	16314	Continuing	Continuing

C. Other Program Funding Summary See paragraph A for related programs.

D. Schedule Profile

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Develop, model and simulate architecture and platforms for National Training Exercise Desert Hammer 6				X*												
Conduct digital brigade command post exercise simulation at Fort Knox Battle Lab								X								
Complete joint CAC2/Combat Identification (ID) demonstration												X				
Demonstrate initial joint digital battlefield simulation linking Army, Navy and Air Force C2 models																X

*Denotes completed effort

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PROJECT: D243

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D243 Sensors and Signal Processing	8604	6092	3290	998	3981	5972	6994	6485	Continuing	Continuing

C. **Other Program Funding Summary.** See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
CGS advanced antenna proof-of-concept stationary demonstration				X*												
Data collection and live fire test of BRWL in field environment								X								
Complete demonstrations of BRWL in Advanced Warfighting Experiments with Depth & Simultaneous Attack Battle Lab												X				
Complete analysis of multisensor mission equipment interface requirements																X

*Denotes completed effort

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PROJECT: D281

COST (*In Thousands*)	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	Cost to Complete	Total Cost
D281 Ground Combat Identification Demonstration	5897	8173	6976	7349	3528	0	0	0	0	31923

C. **Other Program Funding Summary** See paragraph A for related programs.

D. **Schedule Profile**

	FY 1994				FY 1995				FY 1996				FY 1997			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Completed construction of millimeter wave testbed and initiate experimental investigations			X*													
Completed preliminary modeling of CI alternatives for ground platform application				X*												
Complete combat ID situational awareness extension software design modifications						X										
Complete millimeter wave testbed modifications						X										
Complete construction of Air-to-Ground CI prototypes							X									
Complete initial operational field experiments with enhanced BCIS								X								
Complete field demonstrations of Air-to-Ground prototypes									X							
Complete BCIS cost/performance tradeoff experiments and analyses											X					
Complete Task Force XXI with Air-to-Ground systems															X	
Begin upgrade of CI equipment for use in follow-on Battlefield Digitization field exercises																X

*Denotes completed effort