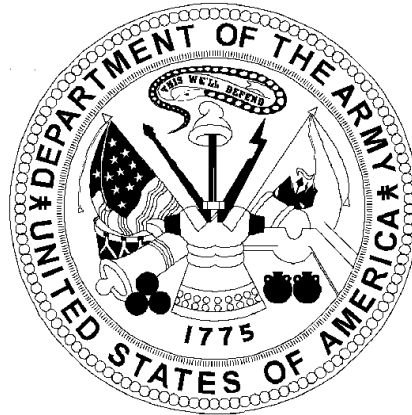


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Supporting Data FY 1998/1999 Budget Estimate  
Submitted to Congress - February 1997

**DESCRIPTIVE SUMMARIES OF THE**



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

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

***"READINESS THROUGH MODERNIZATION"***

**VOLUME I**

**UNCLASSIFIED**

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**DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS  
OF THE  
RESEARCH, DEVELOPMENT, TEST AND  
EVALUATION, ARMY  
FY 1998/1999  
FEBRUARY 1997**

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

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

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FY 1998/1999 RDT&E, ARMY  
PROGRAM ELEMENT DESCRIPTIVE SUMMARIES

INTRODUCTION AND EXPLANATION OF CONTENTS

**1. General.** This section has been prepared for the purpose of providing information concerning the Army Research, Development, Test and Evaluation program. The Descriptive Summaries are comprised of R-2 (Budget Item Justification Sheet) and R-3 (RDT&E Program Element/Project Cost Breakdown) Exhibits which provide narrative information on all RDT&E program elements and projects for the FY 1996, 1997, 1998 and 1999 time period.

**2. Relationship of the FY 1998/1999 Budget Submission to the FY 1997 Budget submitted to Congress .** This paragraph provides a list of program elements restructured, transitioned, or established to provide specific program identification.

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

| <b>OLD</b>                       |  | <b>NEW</b>               |
|----------------------------------|--|--------------------------|
| <b><u>PE/PROJECT</u></b>         | <b><u>NEW PROJECT TITLE</u></b>            | <b><u>PE/PROJECT</u></b> |
| 0601102A/S16                     | Science Base/Combat Casualty Care Research | 0601102A/S14             |
| 0602618A/H81, 0603004A/43A       | Liquid Propellant Technology Program       | 0602618A/H37             |
| 0602624A/H28                     | Fuze Technology                            | 0602624A/H36             |
| 0602712A/H24                     | Camouflage Technology                      | 0602712A/H35             |
| 0602785A/791                     | Personnel System/Performance Technology    | 0602785A/790             |
| 0602787A/825                     | Combat Casualty Care Technology            | 0602787A/874             |
| 0603001A/XXA                     | Force XXI Land Warrior                     | 0603001A/J50             |
| 0603003A/D368                    | Improved Cargo Helicopter                  | 0203744A/D430            |
| 0603004A/L95                     | Landmine Warfare Dev                       | 0603004A/43A             |
| 0603007A/793                     | Training Sys and Education                 | 0603007A/792             |
| 0603313A/D380                    | Guided MLRS                                | 0603778A/D784            |
| 0604760A/DC77                    | Computer Generated Forces                  | 0604760A/DC78            |
| 0605601A/DE90, DE91, DE92, DE93, | Army Test Ranges and Facilities            | 0605601A/DF30            |

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D618,D632 & D630

**A. Program Element Restructures (continued).**

| <b>OLD<br/><u>PE/PROJECT</u></b>                | <b><u>NEW PROJECT TITLE</u></b>                 | <b>NEW<br/><u>PE/PROJECT</u></b> |
|---|---|----------------------------------|
| 0605601A/D630                                   | Non-Major System Test & Design<br>Evaluation    | 0605601A/D699                    |
| 0605641A/D670, D671, D672, D672,<br>D675 & D678 | Survivability Evaluation                        | 0605604A/D734                    |
| 0605706A/D026                                   | Major Systems Test, Design and<br>Evaluation    | 0605706A/M542                    |
| 0303142A/D384 & /D386                           | Automated Communications Manage-<br>ment System | 0303142A/D559                    |

**B. FY 1998 Developmental Transitions .**

| <b><u>FROM<br/>PE/PROJECT</u></b> | <b><u>PROJECT TITLE</u></b>                        | <b><u>TO<br/>PE/PROJECT</u></b> |
|-----------------------------------|--|---------------------------------|
| 0602120A/AH15                     | Dismounted Soldier Combat Identification<br>(CID ) | 0604817A/D902                   |
| 0602303A/214                      | 2.75" Anti-Air Tech Demo                           | 0603313A/549                    |
| 0603313A/387                      | Multi-Purpose Individual Munition                  | 0604802A/284                    |

**C. Establishment of New FY 1998 Program Elements/Projects.** There are no major system new starts. Minor new initiatives for FY 1998, in addition to Congressionally directed initiatives for FY 1997, are shown below with asterisks. The remaining programs listed are outyear initiatives or restructures beyond FY 1998 or were previously funded from other Defense appropriations.

| <b><u>TITLE</u></b>  | <b><u>PE/PROJECT</u></b> |
|--|--------------------------|
| Voice Instructional Device*  | 0602601A/AH39            |
| Plasma Energy Pyrolysis System*  | 0602720A/A876            |
| Western Environmental Technology Office (WETO)<br>Environmental Support* | 0602720A/A877            |
| Neurotoxin Exposure Treatment*   | 0602787A/A838            |
| Cancer Signal/Cancer Cell Proliferation*                                 | 0602787A/A839            |

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Computer-Assisted Minimally Invasive Surgery\* 0602787A/A841  
ENT Minimally Invasive Simulation\* 0602787A/A842

**C. Establishment of New FY 1998 Program Elements/Projects (continued).**

| <u>TITLE</u>  | <u>PE/PROJECT</u> |
|---|-------------------|
| Health Technology Roadmaps*                           | 0602787A/A843     |
| Hepatitis A Vaccine*                                  | 0602787A/A844     |
| Trichloromelamine*                                    | 0603002A/D813     |
| Neurofibromatosis*                                    | 0603002A/D814     |
| National Medical Testbed*                             | 0603002A/D815     |
| Computer-Based Decision Support Systems*              | 0603002A/D816     |
| Computer-Aided Diagnostic Research*                   | 0603002A/D817     |
| Advanced Cancer Detection Center*                     | 0603002A/D818     |
| Nautilus/THEL*  | 0603308A/D989     |
| Battle Integration Center*                            | 0603308A/D997     |
| LCPK for 2.75 Inch Rockets                            | 0603313A/A567     |
| Advanced Light Anti-Armor Weapon System (ALAWS)*      | 0603607A/D664     |
| Future Combat System                                  | 0603645A/DQ19     |
| LTASS   | 0603774AD598      |
| Future Scout Vehicle - Advanced Development*          | 0603645A/D018     |
| Suite of Integrated Infrared Countermeasures Op Test* | 0604270A/D2VT     |
| Arm Treatment & Transport Vehicle                     | 0604640A/DG28     |
| Future Scout Vehicle - EMD                            | 0604645A/D022     |
| Mounted Warrior*                                      | 0604713A/D680     |
| XM982*  | 0604802A/D695     |
| Army Systems Engineering & Warfighting Technical Spt* | 0604805A/D589     |
| Modernization of Utilities*                           | 0605678A/M744     |
| Survivability Evaluation                              | 0605604A/D734     |
| Ground Combat Vehicle HTI*                            | 0203735A/D718     |
| Bradley A3 P3I (BFV A4)                               | 0203735A/D377     |
| Guardrail Common Sensor                               | 0203744A/D028     |
| UH-60 Door Gun*                                       | 0203744A/D504     |
| Force XXI Initiatives*                                | 0203758A/D376     |
| Longbow Hellfire PIP                                  | 0203802A/D785     |
| Joint Precision Approach Landing System (JPALS)       | 0305114A/D711     |

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|  |               |
|--|---------------|
| MLRS Army Technical Architecture*                  | 0603778A/D093 |
| Weapons Systems Modernization Software Maintenance | 0708045A/DE26 |

**D. FY 1998 programs for which funding was shown in the FY 1997 President's Budget Submit (February 1996), but which are no longer funded .**

| <u>PE/PROJECT</u> | <u>TITLE</u>                            | <u>BRIEF EXPLANATION</u>          |
|-------------------|---|-----------------------------------|
| 0203735A/D2UT     | Abrams IOTE                             | Funds transferred to system line. |
| 0601101A/91E      | ILIR-ARI                                | Program terminated                |
| 0601102A/S16      | Science Base/Combat Dentistry Research  | Program terminated                |
| 0602120A/H25      | Nuc Effects Surv Tech                   | Program terminated                |
| 0602624A/H23      | Non-Lethal Weapons Technology           | Program terminated                |
| 0602783A/094      | Tactical Software Technology            | Program terminated                |
| 0603627A/E79      | Smoke, Obscurant - Advanced Development | Funds transferred to system line  |
| 0602787A/825      | Combat Maxillofacial Injury             | Program terminated                |
| 0603001A/594      | Metrology & Calibration                 | Program terminated                |
| 0603001A/J28      | Test Measurement Technology Development | Program terminated                |

Descriptive summaries for PE 0603806A - NBC Defense Systems, AD and PE 0604806A - NBC Defense Systems, ED are not provided in this Army submission. Since these programs were transferred to Defense RDT&E in FY 1996, program details are available in the Defense RDT&E submission under PE 0603884BP and PE 0604384BP.

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

|                    |                    |               |
|--------------------|--------------------|---------------|
| 0203735A/DC64      | 0603003A/DB38/D391 | 0603710A/DC63 |
| 0203806A           | 0603005A/DC62      | 0603851A      |
| 0203808A           | 0603009A           | 0603854A/DC68 |
| 0602601A/AC84/DC83 | 0603013A           | 0604649A/DG15 |
| 0602104A           | 0603017A           | 0604328A/DC71 |
| 0602122A           | 0603018A           |               |
| 0602712A/AC61      | 0603020A           |               |
| 0602786A/AC60      | 0603322A           |               |

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Department of the Army  
FY 1998/1999 RDT&E Program

Exhibit R-1

## Summary

Date: Feb 1997

|   | Thousands of Dollars |                |                |                |
|---|----------------------|----------------|----------------|----------------|
|   | FY 1996              | FY 1997        | FY 1998        | FY 1999        |
| <u>Summary Recap of Budget Activities</u>   |                      |                |                |                |
| Basic Research                              | 181,722              | 179,059        | 198,854        | 210,349        |
| Applied Research                            | 450,837              | 551,558        | 462,935        | 493,665        |
| Advanced Technology Development             | 580,033              | 677,676        | 418,322        | 431,696        |
| Demonstration and Validation                | 454,454              | 558,250        | 523,395        | 445,831        |
| Engineering and Manufacturing Development   | 1,124,738            | 1,141,159      | 1,107,393      | 1,162,925      |
| RDT&E Management Support                    | 1,234,657            | 1,072,165      | 1,136,576      | 1,108,382      |
| Operational Systems Development             | <u>730,971</u>       | <u>750,761</u> | <u>663,368</u> | <u>643,876</u> |
| Total Research Development Test & Eval Army | 4,757,412            | 4,930,628      | 4,510,843      | 4,496,724      |
| <u>Summary Recap of FYDP Programs</u>       |                      |                |                |                |
| Strategic Forces                            | 4,000                | 26,376         | 86,193         | 134,298        |
| General Purpose Forces                      | 560,107              | 541,129        | 403,355        | 354,129        |
| Intelligence and Communications             | 64,814               | 72,633         | 89,316         | 68,413         |
| Research and Development (FYDP Program 6)   | 4,094,970            | 4,242,671      | 3,874,153      | 3,874,693      |
| Central Supply and Maintenance              | 23,699               | 47,819         | 44,326         | 50,086         |
| Administration and Assoc Activities         | 322                  | 0              | 0              | 0              |
| Support of Other Nations                    | <u>9,500</u>         | <u>0</u>       | <u>13,500</u>  | <u>15,105</u>  |
| Total Research Development Test & Eval Army | 4,757,412            | 4,930,628      | 4,510,843      | 4,496,724      |





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Department of the Army  
FY 1998/1999 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Reserach Development Test &amp; Eval Army

Date: Feb 1997

| Line No | Element Number | Item  | Act | Thousands of Dollars |         |         |         |
|---------|----------------|---|-----|----------------------|---------|---------|---------|
|         |                |   |     | FY 1996              | FY 1997 | FY 1998 | FY 1999 |
| 1       | 0601101A       | IN-HOUSE LABORATORY INDEPENDENT RESEARCH      | 1   | 13,657               | 14,393  | 15,113  | 15,828  |
| 2       | 0601102A       | DEFENSE RESEARCH SCIENCES                     | 1   | 121,822              | 119,739 | 138,165 | 141,555 |
| 3       | 0601104A       | UNIVERSITY AND INDUSTRY RESEARCH CENTERS      | 1   | 46,243               | 44,927  | 45,576  | 52,966  |
|         |                | Basic Research                                |     | 181,722              | 179,059 | 198,854 | 210,349 |
| 4       | 0602104A       | TRACTOR ROSE                                  | 2   | 2,484                | 3,065   | 0       | 0       |
| 5       | 0602105A       | MATERIALS TECHNOLOGY                          | 2   | 9,858                | 14,530  | 9,811   | 10,979  |
| 6       | 0602120A       | SENSORS AND ELECTRONIC SURVIVABILITY          | 2   | 26,675               | 19,351  | 19,294  | 19,682  |
| 7       | 0602122A       | TRACTOR HIP                                   | 2   | 5,603                | 7,981   | 7,242   | 8,170   |
| 8       | 0602211A       | AVIATION TECHNOLOGY                           | 2   | 17,853               | 21,898  | 27,282  | 30,281  |
| 9       | 0602270A       | EW TECHNOLOGY                                 | 2   | 14,651               | 15,510  | 16,528  | 18,151  |
| 10      | 0602303A       | MISSILE TECHNOLOGY                            | 2   | 17,535               | 29,144  | 22,335  | 24,002  |
| 11      | 0602308A       | MODELING & SIMULATION TECHNOLOGY              | 2   | 19,466               | 20,652  | 21,059  | 24,287  |
| 12      | 0602601A       | COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY      | 2   | 35,040               | 34,312  | 33,112  | 33,360  |
| 13      | 0602618A       | BALLISTICS TECHNOLOGY                         | 2   | 34,647               | 39,913  | 33,317  | 37,598  |
| 14      | 0602622A       | CHEMICAL, SMOKE AND EQUIP DEFEATING TECHNOLOG | 2   | 1,728                | 2,259   | 4,739   | 6,691   |
| 15      | 0602623A       | JOINT SERVICE SMALL ARMS PROGRAM              | 2   | 4,857                | 4,497   | 4,786   | 5,204   |
| 16      | 0602324A       | WEAPONS AND MUNITIONS TECHNOLOGY              | 2   | 24,297               | 22,246  | 26,980  | 30,613  |
| 17      | 0602705A       | ELECTRONICS AND ELECTRONIC DEVICES            | 2   | 21,134               | 24,351  | 20,192  | 22,374  |
| 18      | 0602709A       | NIGHT VISION TECHNOLOGY                       | 2   | 16,442               | 16,636  | 17,304  | 19,213  |
| 19      | 0602712A       | COUNTERMINE SYSTEMS DEVELOPMENT               | 2   | 0                    | 7,372   | 10,598  | 10,715  |
| 20      | 0602716A       | HUMAN FACTORS ENGINEERING TECHNOLOGY          | 2   | 15,445               | 15,968  | 14,256  | 15,626  |
| 21      | 0602720A       | ENVIRONMENTAL QUALITY TECHNOLOGY              | 2   | 25,537               | 55,178  | 17,519  | 13,869  |
| 22      | 0602782A       | COMMAND, CONTROL, COMMUNICATIONS TECHNOLOG    | 2   | 13,130               | 14,976  | 16,838  | 18,180  |
| 23      | 0602783A       | COMPUTER AND SOFTWARE TECHNOLOGY              | 2   | 3,843                | 6,500   | 679     | 337     |
| 24      | 0602784A       | MILITARY ENGINEERING TECHNOLOGY               | 2   | 33,734               | 38,060  | 36,422  | 40,112  |
| 25      | 0602785A       | MANPOWER/PERSONNEL/TRAINING TECHNOLOGY        | 2   | 7,254                | 9,329   | 9,014   | 9,019   |
| 26      | 0602786A       | LOGISTICS TECHNOLOGY                          | 2   | 26,995               | 21,319  | 17,689  | 18,565  |
| 27      | 0602787A       | MEDICAL TECHNOLOGY                            | 2   | 70,575               | 104,332 | 74,684  | 75,307  |
| 28      | 0602789A       | ARMY ARTIFICIAL INTELLIGENCE TECHNOLOGY       | 2   | 2,054                | 2,179   | 1,255   | 1,330   |
|         |                | Applied Research                              |     | 450,837              | 551,558 | 462,935 | 493,665 |
|         |                | ix  |     |                      |         |         |         |
| 29      | 0603001A       | LOGISTICS ADVANCED TECHNOLOGY                 | 3   | 38,820               | 22,724  | 35,469  | 32,197  |
| 30      | 0603002A       | MEDICAL ADVANCED TECHNOLOGY                   | 3   | 90,591               | 201,198 | 10,677  | 10,959  |

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Department of the Army  
FY 1998/1999 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Reserach Development Test &amp; Eval Army

Date: Feb 1997

| Line No | Element Number | Item  | Act | Thousands of Dollars |         |         |         |
|---------|----------------|---|-----|----------------------|---------|---------|---------|
|         |                |   |     | FY 1996              | FY 1997 | FY 1998 | FY 1999 |
| 31      | 0603003A       | AVIATION ADVANCED TECHNOLOGY                                    | 3   | 48,320               | 56,165  | 31,330  | 29,921  |
| 32      | 0603004A       | WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY                       | 3   | 29,119               | 29,122  | 18,255  | 29,717  |
| 33      | 0603005A       | COMBAT VEHICLE AND AUTOMATIVE ADVANCED TECH                     | 3   | 26,363               | 28,811  | 32,685  | 59,573  |
| 34      | 0603006A       | COMMAND, CONTROL, COMM ADVANCED TECHNOLOGY                      | 3   | 29,323               | 29,379  | 19,688  | 20,911  |
| 35      | 0603007A       | MANPOWER, PERSONNEL AND TRAINING ADV TECH                       | 3   | 4,576                | 4,406   | 3,003   | 3,006   |
| 36      | 0603009A       | TRACTOR HIKE  | 3   | 23,016               | 16,791  | 14,350  | 9,574   |
| 37      | 0603013A       | TRACTOR DIRT  | 3   | 1,713                | 3,265   | 3,393   | 2,448   |
| 38      | 0603017A       | TRACTOR RED   | 3   | 5,369                | 8,445   | 5,572   | 4,953   |
| 39      | 0603020A       | TRACTOR ROSE  | 3   | 4,731                | 4,971   | 9,204   | 9,111   |
| 40      | 0603105A       | MILITARY HIV RESEARCH   | 3   | 2,795                | 17,544  | 2,713   | 3,162   |
| 41      | 0603238A       | Global Surveillance/Air Defense/Precision Strike Technology Den | 3   | 37,630               | 22,009  | 11,664  | 4,926   |
| 42      | 0603270A       | EW TECHNOLOGY   | 3   | 3,818                | 6,651   | 8,182   | 11,754  |
| 43      | 0603313A       | MISSILE AND ROCKET ADVANCED TECHNOLOGY                          | 3   | 109,972              | 99,819  | 117,139 | 89,542  |
| 44      | 0603322A       | TRACTOR CAGE  | 3   | 8,088                | 8,651   | 6,412   | 5,353   |
| 45      | 0603606A       | LANDMINE WARFARE AND BARRIER ADV TECHNOLOGY                     | 3   | 25,006               | 27,629  | 19,332  | 19,778  |
| 46      | 0603607A       | JOINT SERVICE SMALL ARMS PROGRAM                                | 3   | 4,516                | 9,049   | 4,754   | 5,148   |
| 47      | 0603654A       | LINE-OF-SIGHT TECHNOLOGY DEMO                                   | 3   | 13,396               | 9,791   | 13,000  | 20,000  |
| 48      | 0603710A       | NIGHT VISION ADVANCED TECHNOLOGY                                | 3   | 31,142               | 29,761  | 19,299  | 19,250  |
| 49      | 0603734A       | MILITARY ENGINEERING ADVANCED TECHNOLOGY                        | 3   | 14,544               | 20,213  | 12,231  | 17,334  |
| 50      | 0603772A       | ADV TACTICAL COMPUTER SCIENCE & SENSOR TECH                     | 3   | 27,185               | 21,282  | 19,970  | 23,079  |
|         |                | Advanced Technology Development                                 |     | 580,033              | 677,676 | 418,322 | 431,696 |
| 51      | 0603018A       | TRACTOR TREAD   | 4   | 14,158               | 2,329   | 0       | 0       |
| 52      | 0603308A       | ARMY MISSILE DEFENSE SYSTEMS INTEGRATION                        | 4   | 23,443               | 66,462  | 24,138  | 12,637  |
| 53      | 0603619A       | LANDMINE WARFARE AND BARRIER - ADV DEV                          | 4   | 35,768               | 27,860  | 18,882  | 11,214  |
| 54      | 0603627A       | SMOKE, OBSCURANT AND TARGET DEFEATING SYS-AD                    | 4   | 2,623                | 6,246   | 0       | 0       |
| 55      | 0603639A       | ARMAMENT ENHANCEMENT INITIATIVE                                 | 4   | 58,227               | 63,240  | 40,313  | 18,982  |
| 56      | 0603640A       | ARTILLERY PROPELLANT DEVELOPMENT                                | 4   | 20,811               | 8,322   | 8,521   | 0       |
| 57      | 0603645A       | ARMORED SYSTEMS MODERNIZATION-ADVANCED DEVI                     | 4   | 181,647              | 7,803   | 2,007   | 2,008   |
|         |                | x   |     |                      |         |         |         |
| 58      | 0603649A       | ENGINEER MOB EQUIP ADVANCED DEV                                 | 4   | 13,591               | 0       | 0       | 0       |
| 59      | 0603653A       | ADVANCED TANK ARMAMENT SYSTEM                                   | 4   | 9,335                | 11,395  | 8,982   | 8,928   |
| 60      | 0603713A       | ARMY DATA DISTRIBUTION SYTEM                                    | 4   | 6,360                | 23,170  | 21,214  | 10,049  |
| 61      | 0603745A       | TACTICAL ELECTRONIC SUPPORT SYSTEMS - ADV DEV                   | 4   | 5,630                | 3,941   | 0       | 0       |

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Department of the Army  
FY 1998/1999 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Reserach Development Test &amp; Eval Army

Date: Feb 1997

| Line No | Element Number | Program Item                                  | Act | Thousands of Dollars |          |          |          |
|---------|----------------|---|-----|----------------------|----------|----------|----------|
|         |                |   |     | FY 1996              | FY 1997  | FY 1998  | FY 1999  |
| 62      | 0603747A       | SOLDIER SUPPORT AND SURVIVABILITY             | 4   | 6,709                | 6,541    | 7,557    | 7,680    |
| 63      | 0603766A       | TAC EXPLOIT OF NAT CAP (TENCAP)-DEM/VAL TIARA | 4   | 26,796               | 25,354   | 20,920   | 23,714   |
| 64      | 0603774A       | NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT     | 4   | 3,167                | 2,769    | 2,939    | 2,893    |
| 65      | 0603790A       | NATO RESEARCH AND DEVELOPMENT (H)             | 4   | 0                    | 9,755    | 13,168   | 11,169   |
| 66      | 0603801A       | AVIATION - ADV DEV                            | 4   | 12,893               | 13,104   | 7,132    | 7,450    |
| 67      | 0603802A       | WEAPONS AND MUNITIONS - ADV DEV               | 4   | 949                  | 0        | 0        | 0        |
| 68      | 0603804A       | LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV    | 4   | 5,587                | 7,433    | 6,783    | 6,833    |
| 69      | 0603805A       | CBT SERVICE SUPPORT CONTROL SYS EVAL & ANALYS | 4   | 13,228               | 12,689   | 7,673    | 7,783    |
| 70      | 0603807A       | MEDICAL SYSTEMS - ADV DEV                     | 4   | 9,878                | 9,996    | 6,765    | 8,700    |
| 71      | 0603851A       | TRACTOR CAGE (Dem/Val)                        | 4   | 3,234                | 3,001    | 1,948    | 1,627    |
| 72      | 0603854A       | ARTILLERY SYSTEMS DEMONSTRATION/VALIDATION    | 4   | 0                    | 238,590  | 324,380  | 294,495  |
| 73      | 0603856A       | SCAMP BLOCK II (SPACE)                        | 4   | 0                    | 8,250    | 73       | 9,669    |
| 74      | 0603889A       | COUNTERDRUG R&D PROJECTS                      | 4   | <u>420</u>           | <u>0</u> | <u>0</u> | <u>0</u> |
|         |                | Demonstration and Validation                  |     | 454,454              | 558,250  | 523,395  | 445,831  |
| 75      | 0604201A       | AIRCRAFT AVIONICS                             | 5   | 20,073               | 14,694   | 21,669   | 12,729   |
| 76      | 0604220A       | ARMED, DEPLOYABLE OH-58D                      | 5   | 688                  | 1,130    | 0        | 0        |
| 77      | 0604223A       | COMANCHE                                      | 5   | 284,131              | 331,424  | 282,009  | 371,927  |
| 78      | 0604270A       | EW DEVELOPMENT                                | 5   | 62,250               | 73,886   | 66,212   | 51,490   |
| 79      | 0604321A       | ALL SOURCE ANALYSIS SYSTEM                    | 5   | 49,912               | 39,308   | 24,045   | 26,228   |
| 80      | 0604325A       | FOLLOW-ON TO TOW                              | 5   | 944                  | 5,479    | 13,949   | 50,884   |
| 81      | 0604328A       | TRACTOR CAGE                                  | 5   | 0                    | 1,524    | 11       | 303      |
| 82      | 0604604A       | MEDIUM TACTICAL VEHICLES                      | 5   | 2,923                | 5,874    | 3,729    | 0        |
| 83      | 0604609A       | SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ED  | 5   | 1,915                | 0        | 0        | 703      |
| 84      | 0604611A       | JAVELIN (AWWS-M)                              | 5   | 2,249                | 6,014    | 8,018    | 5,277    |
| 85      | 0604619A       | LANDMINE WARFARE                              | 5   | 29,453               | 26,288   | 19,800   | 23,075   |
| 86      | 0604622A       | FAMILY OF HEAVY TACTICAL VEHICLES             | 5   | 2,605                | 1,958    | 0        | 0        |
|         |                | xi  |     |                      |          |          |          |
| 87      | 0604633A       | AIR TRAFFIC CONTROL                           | 5   | 5,073                | 7,377    | 1,705    | 1,729    |
| 88      | 0604640A       | ADVANCED COMMAND AND CONTROL VEHICLE          | 5   | 17,306               | 7,734    | 8,867    | 0        |
| 89      | 0604641A       | TACTICAL UNMANNED GROUND VEHICLE              | 5   | 0                    | 2,823    | 2,687    | 2,663    |
| 90      | 0604642A       | LIGHT TACTICLE WHEELED VEHICLE                | 5   | 3,970                | 2,937    | 9,909    | 39,919   |
| 91      | 0604645A       | ARMORED SYSTEMS MODERNIZATION (ASM)-ENG DEV   | 5   | 32,425               | 6,585    | 0        | 0        |
| 92      | 0604649A       | ENGINEER MOBILITY EQUIPMENT DEVELOPMENT       | 5   | 19,114               | 46,705   | 56,196   | 63,069   |

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Department of the Army  
FY 1998/1999 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Reserach Development Test &amp; Eval Army

Date: Feb 1997

| Line No                                   | Element Number | Program Item                                  | Act | Thousands of Dollars |              |           |            |
|---|----------------|---|-----|----------------------|--------------|-----------|------------|
|   |                |   |     | FY 1996              | FY 1997      | FY 1998   | FY 1999    |
| 93  | 0604710A       | NIGHT VISION SYSTEMS - ENG DEV                | 5   | 37,658               | 34,870       | 33,456    | 21,255     |
| 94  | 0604713A       | COMBAT FEEDING, CLOTHING, AND EQUIPMENT       | 5   | 16,049               | 76,428       | 55,964    | 43,539     |
| 95  | 0604715A       | NON-SYSTEM TRAINING DEVICES - ENG DEV         | 5   | 50,140               | 48,788       | 76,749    | 73,048     |
| 96  | 0604716A       | TERRAIN INFORMATION - ENG DEV                 | 5   | 8,509                | 7,144        | 2,942     | 2,686      |
| 97  | 0604726A       | INTEGRATED METEOROLOGICAL SUPPORT SYSTEM      | 5   | 0                    | 0            | 1,946     | 1,931      |
| 98  | 0604739A       | JTT/CIBS-M (TIARA)                            | 5   | 0                    | 4,765        | 4,499     | 4,447      |
| 99  | 0604740A       | TACTICAL SURVEILLANCE SYSTEM - ENG DEV        | 5   | 2,954                | 0            | 0         | 0          |
| 100                                       | 0604741A       | AIR DEFENSE C2I - ENG DEV                     | 5   | 21,810               | 20,031       | 18,350    | 6,698      |
| 101                                       | 0604746A       | AUTOMATIC TEST EQUIPMENT DEVELOPMENT          | 5   | 10,648               | 9,575        | 2,582     | 2,533      |
| 102                                       | 0604760A       | DISTRIBUTIVE INTERACTIVE SIMULATIONS ENG DEV  | 5   | 0                    | 15,631       | 20,895    | 9,242      |
| 103                                       | 0604766A       | TAC EXPLOIT NAT CAP (TENCAP)-EMD (TIARA)      | 5   | 23,266               | 15,235       | 19,113    | 19,531     |
| 104                                       | 0604768A       | BRILLIANT ANTI-ARMOR SUBMUNITION(BAT)         | 5   | 190,472              | 161,816      | 202,302   | 129,466    |
| 105                                       | 0604770A       | JOINT SURVEILLANCE/TARGET ATTACK RADAR SYSTEM | 5   | 15,302               | 9,624        | 6,940     | 5,670      |
| 106                                       | 0604778A       | POSITIONING SYS DEVEL (SPACE)                 | 5   | 436                  | 428          | 419       | 409        |
| 107                                       | 0604780A       | COMBINED ARMS TACTICAL TRAINER (CATT)         | 5   | 56,282               | 26,110       | 2,823     | 2,866      |
| 108                                       | 0604801A       | AVIATION - ENG DEV                            | 5   | 4,885                | 5,403        | 5,109     | 6,067      |
| 109                                       | 0604802A       | WEAPONS AND MUNITIONS - ENG DEV               | 5   | 14,845               | 23,661       | 3,577     | 24,865     |
| 110                                       | 0604804A       | LOGISTICS & ENGINEER EQUIPMENT - ENG DEV      | 5   | 19,132               | 19,903       | 28,039    | 26,932     |
| 111                                       | 0604805A       | COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - EI | 5   | 16,740               | 9,556        | 11,052    | 16,395     |
| 112                                       | 0604807A       | MEDICAL MATERIEL/MED BIO DEFENSE EQUIPMENT ED | 5   | 4,644                | 4,693        | 4,483     | 5,408      |
| 113                                       | 0604808A       | LANDMINE WARFARE/BARRIER - ENG DEV            | 5   | 6,802                | 7,556        | 22,605    | 44,133     |
| 114                                       | 0604814A       | SENSE AND DESTROY ARMOR - ENG DEV             | 5   | 15,764               | 9,934        | 22,372    | 20,813     |
| 115                                       | 0604816A       | LONGBOW                                       | 5   | 21,969               | 10,644       | 0         | 0          |
| 116                                       | 0604817A       | COMBAT IDENTIFICATION                         | 5   | 23,669               | 16,411       | 19,784    | 13,379     |
| 117                                       | 0604818A       | ARMY TACTICAL COMM & CONT HARDWARE & SOFTWARE | 5   | 27,231               | 15,780       | 20,022    | 18,697     |
| 118                                       | 0604820A       | RADAR DEVELOPMENT                             | 5   | 500                  | 0            | 0         | 0          |
| xii                                       |                |   |     |                      |              |           |            |
| 119                                       | 0604823A       | FIREFINDER                                    | 5   | 0                    | 2,496        | 2,564     | 12,022     |
| 120                                       | 0604854A       | ARTILLERY SYSTEMS - ENGINEERING DEVELOPMENT   | 5   | <u>0</u>             | <u>2,937</u> | <u>0</u>  | <u>897</u> |
| Engineering and Manufacturing Development |                |   |     | 1,124,738            | 1,141,159    | 1,107,393 | 1,162,925  |
| 121                                       | 0604256A       | THREAT SIMULATOR DEVELOPMENT                  | 6   | 13,705               | 11,383       | 14,004    | 11,877     |
| 122                                       | 0604258A       | TARGET SYSTEMS DEVELOPMENT                    | 6   | 13,557               | 9,916        | 11,688    | 13,063     |
| 123                                       | 0604759A       | MAJOR TEST & EVALUATION INVESTMENT            | 6   | 62,154               | 40,833       | 40,449    | 33,407     |

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FY 1998/1999 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Reserach Development Test &amp; Eval Army

Date: Feb 1997

| Line | Element  | Program | Item  | Act | Thousands of Dollars |           |           |           |
|------|----------|---------|---|-----|----------------------|-----------|-----------|-----------|
|      |          |         |   |     | FY 1996              | FY 1997   | FY 1998   | FY 1999   |
| No   | Number   |         |   |     |                      |           |           |           |
| 124  | 0605103A |         | RAND ARROYO CENTER                            | 6   | 17,895               | 21,108    | 17,576    | 18,040    |
| 125  | 0605301A |         | ARMY KWAJALEIN ATOLL                          | 6   | 140,930              | 143,789   | 138,769   | 142,125   |
| 126  | 0605502A |         | SMALL BUS INV RSCH/SMALL BUS TECH PILOT PROG  | 6   | 85,919               | 0         | 0         | 0         |
| 127  | 0605601A |         | ARMY TEST RANGES AND FACILITIES               | 6   | 142,694              | 130,222   | 122,117   | 128,919   |
| 128  | 0605602A |         | ARMY TECHNOLOGY & SUSTAINING INSTRUMENTATION  | 6   | 25,422               | 21,944    | 33,184    | 32,976    |
| 129  | 0605604A |         | SURVIVABILITY/LETHALITY ANALYSIS              | 6   | 32,250               | 30,675    | 32,330    | 30,678    |
| 130  | 0605605A |         | DOD HIGH ENERGY LASER SYS TEST FAC (HELSTF)   | 6   | 33,231               | 29,974    | 14,952    | 14,976    |
| 131  | 0605606A |         | AIRCRAFT CERTIFICATION                        | 6   | 2,821                | 2,840     | 2,919     | 2,924     |
| 132  | 0605702A |         | METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES    | 6   | 6,458                | 6,348     | 6,434     | 6,658     |
| 133  | 0605706A |         | MATERIEL SYSTEMS ANALYSIS                     | 6   | 17,241               | 14,126    | 29,707    | 28,675    |
| 134  | 0605709A |         | EXPLOITATION OF FOREIGN ITEMS                 | 6   | 8,413                | 7,193     | 7,762     | 4,349     |
| 135  | 0605712A |         | SUPPORT OF OPERATIONAL TESTING                | 6   | 41,078               | 49,614    | 81,672    | 68,949    |
| 136  | 0605801A |         | PROGRAMWIDE ACTIVITIES                        | 6   | 64,859               | 59,708    | 86,208    | 85,604    |
| 137  | 0605802A |         | INTERNATIONAL COOPERATIVE RESEARCH AND DEV    | 6   | 1,555                | 1,534     | 1,581     | 1,581     |
| 138  | 0605803A |         | TECHNICAL INFORMATION ACTIVITIES              | 6   | 13,549               | 16,552    | 15,451    | 15,872    |
| 139  | 0605805A |         | MUNITIONS STANDARDZION EFFECTIVENESS & SAFETY | 6   | 16,692               | 3,211     | 6,317     | 5,895     |
| 140  | 0605853A |         | ENVIRONMENTAL CONSERVATION                    | 6   | 2,493                | 1,723     | 1,778     | 2,977     |
| 141  | 0605854A |         | POLLUTION PREVENTION                          | 6   | 11,004               | 13,602    | 5,353     | 4,681     |
| 142  | 0605856A |         | ENVIRONMENTAL COMPLIANCE-RDT&E                | 6   | 65,985               | 54,251    | 51,378    | 47,604    |
| 143  | 0605876A |         | MINOR CONSTUCTION (RPM) - RDTE                | 6   | 6,035                | 4,229     | 4,393     | 4,537     |
| 144  | 0605878A |         | MAINTENANCE AND REPAIR (RPM) - RDTE           | 6   | 86,907               | 68,580    | 85,119    | 74,681    |
| 145  | 0605879A |         | REAL PROPERTY SERVICES (RPS)                  | 6   | 0                    | 90,457    | 88,945    | 88,936    |
| 146  | 0605896A |         | BASE OPERATIONS-RDT&E                         | 6   | 306,481              | 219,946   | 231,653   | 233,633   |
|      |          |         |   |     | xiii                 |           |           |           |
| 147  | 0605898A |         | MANAGEMENT HEADQUARTERS (RSCH & DEVELOPMEN'   | 6   | 15,007               | 18,407    | 4,837     | 4,765     |
| 148  | 0909999A |         | CLOSED ACCOUNT ADJUSTMENT                     | 6   | 322                  | 0         | 0         | 0         |
|      |          |         | RDT&E Management Support                      |     | 1,234,657            | 1,072,165 | 1,136,576 | 1,108,382 |
| 149  | 0603778A |         | MLRS PRODUCT IMPROVEMENT PROGRAM              | 7   | 68,851               | 62,804    | 26,678    | 21,845    |
| 150  | 0102419A |         | AEROSTAT JOINT PROGRAM                        | 7   | 4,000                | 26,376    | 86,193    | 134,298   |
| 151  | 0203726A |         | ADV FIELD ARTILLERY TACTICAL DATA SYSTEM      | 7   | 36,973               | 38,512    | 39,039    | 34,939    |
| 152  | 0203735A |         | COMBAT VEHICLE IMPROVEMENT PROGRAMS           | 7   | 206,625              | 206,816   | 136,520   | 69,443    |
| 153  | 0203740A |         | MANEUVER CONTROL SYSTEM                       | 7   | 48,302               | 27,888    | 25,641    | 23,932    |
| 154  | 0203744A |         | AIRCRAFT MODIFICATIONS/PRODUCT IMPROV PROGRAM | 7   | 4,288                | 22,386    | 2,609     | 28,791    |

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Department of the Army  
FY 1998/1999 RDT&E Program

Exhibit R-1

Appropriation: 2040 A Reserach Development Test &amp; Eval Army

Date: Feb 1997

| Program |                                       | Thousands of Dollars                         |     |              |           |               |               |
|---------|---------------------------------------|--|-----|--------------|-----------|---------------|---------------|
| Line    | Element                               |  | Act | FY 1996      | FY 1997   | FY 1998       | FY 1999       |
| No      | Number                                | Item   |     |              |           |               |               |
| 155     | 0203752A                              | AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGR  | 7   | 3,703        | 3,834     | 2,940         | 2,933         |
| 156     | 0203758A                              | DIGITIZATION                                 | 7   | 110,583      | 137,078   | 156,960       | 149,015       |
| 157     | 0203801A                              | MISSILE/AIR DEFENSE PRODUCT IMPRV PROGRAM    | 7   | 59,199       | 64,557    | 17,412        | 11,431        |
| 158     | 0203802A                              | OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS   | 7   | 64,920       | 9,874     | 1,255         | 17,011        |
| 159     | 0203806A                              | TRACTOR RUT                                  | 7   | 3,346        | 3,112     | 2,111         | 0             |
| 160     | 0203808A                              | TRACTOR CARD                                 | 7   | 9,521        | 6,766     | 6,690         | 6,693         |
| 161     | 0208010A                              | JOINT TACTICAL COMMUNICATIONS PROG (TRI-TAC) | 7   | 12,647       | 18,229    | 8,983         | 9,941         |
| 162     | 0208053A                              | JOINT TACTICAL GRD STATION (TIARA)           | 7   | 0            | 2,077     | 3,195         | 0             |
| 163     | 0301359A                              | SPECIAL ARMY PROGRAM                         | 7   | 8,538        | 10,185    | 5,547         | 4,551         |
| 164     | 0303140A                              | COMMUNICATIONS SECURITY (COMSEC) EQUIPMENT   | 7   | 3,455        | 3,161     | 9,647         | 3,826         |
| 165     | 0303142A                              | SATCOM GROUND ENVIRO (SPACE)                 | 7   | 52,821       | 39,421    | 57,827        | 44,288        |
| 166     | 0303150A                              | ARMY GLOBAL C2 SYS                           | 7   | 0            | 19,389    | 15,045        | 14,793        |
| 167     | 0305114A                              | TRAFFIC CNTL/APPROACH/LANDING SYS (JPALS)    | 7   | 0            | 0         | 750           | 0             |
| 168     | 0305128A                              | SECURITY AND INTELLIGENCE ACTIVITIES         | 7   | 0            | 477       | 500           | 955           |
| 169     | 0708045A                              | End Item Industrial Preparedness Activities  | 7   | 23,699       | 47,819    | 44,326        | 50,086        |
| 170     | 1001018A                              | NATO JSTARS - TIARA                          | 7   | <u>9,500</u> | <u>0</u>  | <u>13,500</u> | <u>15,105</u> |
|         |                                       | Operational Systems Development              |     | 730,971      | 750,761   | 663,368       | 643,876       |
| Total   | Research Development Test & Eval Army |  |     | 4,757,412    | 4,930,628 | 4,510,843     | 4,496,724     |

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**ARMY  
FY97 COLUMN OF FY98/99 PRES BUD**

|   |           |             |               |                 |                 |              |                   |                   |                |
|---|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
| The spreadsheet below reflects the FY97 column of the FY98/99 President's Budget by project. It is provided as clarification to the attached descriptive summaries. In the Project Change Summary (paragraph B of Exhibit R-2), we have reflected the FY97 Appropriated Value as the amount Congress appropriated less undistributed reductions in Sections 8136, 8138, and 8037 (column G of spreadsheet). This methodology is consistent with past practices and is consistent throughout this submission. However, we just recently realized that we should have shown the amount appropriated prior to any reductions (column A), and the total of those reductions (column F) as Adjustments to Appropriated Value. Unfortunately, time did not allow us to change over 400 descriptive summaries before the deadline for this submission. We intend to use this methodology for all future submissions. |           |             |               |                 |                 |              |                   |                   |                |
|   |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|   |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|   |           |             |               |                 |                 |              |                   |                   |                |
|   |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|   |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b>   | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 1   | 61101     | 91A         | 9893          | -198            | -9              |              |                   | -207              | 9686           |
| 1   | 61101     | 91C         | 3910          | -78             | -4              |              |                   | -82               | 3828           |
| 1   | 61101     | 91D         | 768           | -15             | -1              |              |                   | -16               | 752            |
| 1   | 61101     | 91E         | 130           | -3              | 0               |              |                   | -3                | 127            |
|   |           |             | 14701         | -294            | -14             | 0            | 0                 | -308              | 14393          |
| 1   | 61102     | 305         | 1156          | -23             | -1              |              |                   | -24               | 1132           |
| 1   | 61102     | 31B         | 2281          | -46             | -2              |              |                   | -48               | 2233           |
| 1   | 61102     | 52C         | 2243          | -45             | -2              |              |                   | -47               | 2196           |
| 1   | 61102     | 53A         | 3605          | -72             | -3              |              |                   | -75               | 3530           |
| 1   | 61102     | 74A         | 2303          | -46             | -2              |              |                   | -48               | 2255           |
| 1   | 61102     | 74F         | 2462          | -49             | -2              |              |                   | -51               | 2411           |
| 1   | 61102     | F20         | 2333          | -47             | -2              |              |                   | -49               | 2284           |
| 1   | 61102     | F22         | 447           | -9              | 0               |              |                   | -9                | 438            |
| 1   | 61102     | H42         | 1775          | -35             | -2              |              |                   | -37               | 1738           |
| 1   | 61102     | H43         | 5584          | -112            | -6              |              |                   | -118              | 5466           |
| 1   | 61102     | H44         | 3354          | -67             | -3              |              |                   | -70               | 3284           |
| 1   | 61102     | H45         | 1848          | -37             | -2              |              |                   | -39               | 1809           |
| 1   | 61102     | H47         | 2811          | -56             | -4              |              |                   | -60               | 2751           |
| 1   | 61102     | H48         | 6872          | -137            | -6              |              |                   | -143              | 6729           |
| 1   | 61102     | H52         | 849           | -17             | -1              |              |                   | -18               | 831            |
| 1   | 61102     | H57         | 47844         | -957            | -45             | -22          | -8                | -1032             | 46812          |
| 1   | 61102     | H66         | 1314          | -26             | -1              |              |                   | -27               | 1287           |
| 1   | 61102     | H67         | 4901          | -98             | -5              |              |                   | -103              | 4798           |



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ARMY  
FY97 COLUMN OF FY98/99 PRES BUD

|           |                   |             | A             | B               | C               | D            | E                 | F                 | G              |
|-----------|-------------------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |                   |             |               |                 |                 |              |                   | (B+C+D+E)         | (A-F)          |
|           |                   |             |               |                 |                 |              |                   |                   |                |
|           |                   |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |                   |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b>         | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 1         | 61102             | H68         | 350           | -7              | 0               |              |                   | -7                | 343            |
| 1         | 61102             | S04         | 598           | -12             | -1              |              |                   | -13               | 585            |
| 1         | 61102             | S13         | 8430          | -169            | -8              |              |                   | -177              | 8253           |
| 1         | 61102             | S14         | 3830          | -77             | -4              |              |                   | -81               | 3749           |
| 1         | 61102             | S15         | 5661          | -113            | -5              |              |                   | -118              | 5543           |
| 1         | 61102             | S16         | 468           | -9              | 0               |              |                   | -9                | 459            |
| 1         | 61102             | S17         | 800           | -16             | -1              |              |                   | -17               | 783            |
| 1         | 61102             | T22         | 1767          | -35             | -2              |              |                   | -37               | 1730           |
| 1         | 61102             | T23         | 1532          | -31             | -1              |              |                   | -32               | 1500           |
| 1         | 61102             | T24         | 1128          | -23             | -1              |              |                   | -24               | 1104           |
| 1         | 61102             | T25         | 3136          | -63             | -3              |              |                   | -66               | 3070           |
| 1         | 61102             | S18         | 650           | -13             | -1              |              |                   | -14               | 636            |
|           |                   |             | 122332        | -2447           | -116            | -22          | -8                | -2593             | 119739         |
| 1         | 61104             | H50         | 6853          | -137            | -6              |              |                   | -143              | 6710           |
| 1         | 61104             | H53         | 690           | -14             | -1              |              |                   | -15               | 675            |
| 1         | 61104             | H54         | 7252          | -145            | -7              |              |                   | -152              | 7100           |
| 1         | 61104             | H56         | 4469          | -89             | -4              |              |                   | -93               | 4376           |
| 1         | 61104             | H59         | 5797          | -116            | -5              |              |                   | -121              | 5676           |
| 1         | 61104             | H62         | 10043         | -201            | -9              |              |                   | -210              | 9833           |
| 1         | 61104             | H64         | 2899          | -58             | -3              |              |                   | -61               | 2838           |
| 1         | 61104             | H65         | 2899          | -58             | -3              |              |                   | -61               | 2838           |
| 1         | 61104             | H73         | 4986          | -100            | -5              |              |                   | -105              | 4881           |
|           |                   |             | 45888         | -918            | -43             | 0            | 0                 | -961              | 44927          |
|           | <b>TOTAL BA 1</b> |             | <b>182921</b> | <b>-3659</b>    | <b>-173</b>     | <b>-22</b>   | <b>-8</b>         | <b>-3862</b>      | <b>179059</b>  |
| 2         | 62104             | B79         | 3131          | -63             | -3              |              |                   | -66               | 3065           |
|           |                   |             | 3131          | -63             | -3              | 0            | 0                 | -66               | 3065           |
| 2         | 62105             | H84         | 14841         | -297            | -14             |              |                   | -311              | 14530          |
|           |                   |             | 14841         | -297            | -14             | 0            | 0                 | -311              | 14530          |

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**ARMY**  
**FY97 COLUMN OF FY98/99 PRES BUD**

|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 2         | 62120     | 140         | 2651          | -53             | -2              |              |                   | -55               | 2596           |
| 2         | 62120     | H15         | 3686          | -74             | -3              |              | -5                | -82               | 3604           |
| 2         | 62120     | H16         | 13455         | -269            | -13             | -22          |                   | -304              | 13151          |
| 2         | 62120     | H25         | 0             | 0               | 0               |              |                   | 0                 | 0              |
|           |           |             | 19792         | -396            | -18             | -22          | -5                | -441              | 19351          |
| 2         | 62122     | 622         | 8152          | -163            | -8              |              |                   | -171              | 7981           |
|           |           |             | 8152          | -163            | -8              | 0            | 0                 | -171              | 7981           |
| 2         | 62211     | 47A         | 19640         | -393            | -18             |              | -16               | -427              | 19213          |
| 2         | 62211     | 47B         | 2743          | -55             | -3              |              |                   | -58               | 2685           |
|           |           |             | 22383         | -448            | -21             | 0            | -16               | -485              | 21898          |
| 2         | 62270     | 442         | 8783          | -176            | -8              |              |                   | -184              | 8599           |
| 2         | 62270     | 906         | 7062          | -141            | -7              | -3           |                   | -151              | 6911           |
|           |           |             | 15845         | -317            | -15             | -3           | 0                 | -335              | 15510          |
| 2         | 62303     | 214         | 25795         | -516            | -24             |              | -27               | -567              | 25228          |
| 2         | 62303     | 205         | 4000          | -80             | -4              |              |                   | -84               | 3916           |
|           |           |             | 29795         | -596            | -28             | 0            | -27               | -651              | 29144          |
| 2         | 62308     | C90         | 9516          | -190            | -9              | -19          |                   | -218              | 9298           |
| 2         | 62308     | C99         | 11618         | -232            | -11             | -21          |                   | -264              | 11354          |
|           |           |             | 21134         | -422            | -20             | -40          | 0                 | -482              | 20652          |
| 2         | 62601     | C05         | 5982          | -120            | -6              |              | -2                | -128              | 5854           |
| 2         | 62601     | H39         | 2100          | -42             | -2              |              |                   | -44               | 2056           |
| 2         | 62601     | H77         | 10544         | -211            | -10             |              | -5                | -226              | 10318          |
| 2         | 62601     | H82         | 3090          | -62             | -3              |              |                   | -65               | 3025           |
| 2         | 62601     | H91         | 13384         | -268            | -13             | -5           | -39               | -325              | 13059          |
|           |           |             | 35100         | -703            | -34             | -5           | -46               | -788              | 34312          |
| 2         | 62618     | H75         | 8007          | -160            | -8              |              |                   | -168              | 7839           |

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**FY97 COLUMN OF FY98/99 PRES BUD**

|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 2         | 62618     | H37         | 7500          | -150            | -7              |              |                   | -157              | 7343           |
| 2         | 62618     | H80         | 20762         | -415            | -19             |              |                   | -434              | 20328          |
| 2         | 62618     | H81         | 4497          | -90             | -4              |              |                   | -94               | 4403           |
|           |           |             | 40766         | -815            | -38             | 0            | 0                 | -853              | 39913          |
| 2         | 62622     | 552         | 2343          | -47             | -2              | -34          | -1                | -84               | 2259           |
|           |           |             | 2343          | -47             | -2              | -34          | -1                | -84               | 2259           |
| 2         | 62623     | H21         | 4593          | -92             | -4              |              |                   | -96               | 4497           |
|           |           |             | 4593          | -92             | -4              | 0            | 0                 | -96               | 4497           |
| 2         | 62624     | H18         | 9484          | -190            | -9              | -9           | -3                | -211              | 9273           |
| 2         | 62624     | H19         | 5039          | -101            | -5              |              |                   | -106              | 4933           |
| 2         | 62624     | H28         | 8214          | -164            | -8              |              | -2                | -174              | 8040           |
|           |           |             | 22737         | -455            | -22             | -9           | -5                | -491              | 22246          |
| 2         | 62705     | H11         | 6073          | -121            | -6              |              |                   | -127              | 5946           |
| 2         | 62705     | H94         | 18799         | -376            | -18             |              |                   | -394              | 18405          |
|           |           |             | 24872         | -497            | -24             | 0            | 0                 | -521              | 24351          |
| 2         | 62709     | H95         | 16994         | -340            | -16             | -2           |                   | -358              | 16636          |
|           |           |             | 16994         | -340            | -16             | -2           | 0                 | -358              | 16636          |
| 2         | 62712     | C61         | 1359          | -27             | -1              |              |                   | -28               | 1331           |
| 2         | 62712     | H24         | 6170          | -123            | -6              |              |                   | -129              | 6041           |
|           |           |             | 7529          | -150            | -7              | 0            | 0                 | -157              | 7372           |
| 2         | 62716     | H70         | 14072         | -281            | -13             | -13          |                   | -307              | 13765          |
| 2         | 62716     | H34         | 2250          | -45             | -2              |              |                   | -47               | 2203           |
|           |           |             | 16322         | -326            | -15             | -13          | 0                 | -354              | 15968          |
| 2         | 62720     | 048         | 6072          | -121            | -6              |              |                   | -127              | 5945           |

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|           |           |             | A            | B               | C               | D            | E               | F            | G              |
|-----------|-----------|-------------|--------------|-----------------|-----------------|--------------|-----------------|--------------|----------------|
|           |           |             |              |                 |                 |              |                 | (B+C+D+E)    | (A-F)          |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             | FY 97        |                 |                 |              | Sec 8037        | Tot Adj to   | FY 97          |
|           |           |             | Approp       |                 |                 |              | Consulting      | Approp       | Column         |
| <u>BA</u> | <u>PE</u> | <u>Proj</u> | <u>Value</u> | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u> | <u>on RDDS</u> |
| 2         | 62720     | 876         | 7500         | -150            | -7              |              |                 | -157         | 7343           |
| 2         | 62720     | 877         | 5000         | -100            | -5              |              |                 | -105         | 4895           |
| 2         | 62720     | 822         | 2000         | -40             | -2              |              |                 | -42          | 1958           |
| 2         | 62720     | 823         | 5400         | -108            | -5              |              |                 | -113         | 5287           |
| 2         | 62720     | 826         | 4000         | -80             | -4              |              |                 | -84          | 3916           |
| 2         | 62720     | 829         | 13170        | -263            | -12             |              |                 | -275         | 12895          |
| 2         | 62720     | 835         | 3169         | -63             | -3              |              |                 | -66          | 3103           |
| 2         | 62720     | 896         | 7412         | -148            | -7              |              |                 | -155         | 7257           |
| 2         | 62720     | F25         | 2634         | -53             | -2              |              |                 | -55          | 2579           |
|           |           |             | 56357        | -1126           | -53             | 0            | 0               | -1179        | 55178          |
| 2         | 62782     | 779         | 7265         | -145            | -7              |              |                 | -152         | 7113           |
| 2         | 62782     | H92         | 8042         | -161            | -8              | -10          |                 | -179         | 7863           |
|           |           |             | 15307        | -306            | -15             | -10          | 0               | -331         | 14976          |
| 2         | 62783     | 094         | 4321         | -86             | -4              |              |                 | -90          | 4231           |
| 2         | 62783     | Y10         | 2317         | -46             | -2              |              |                 | -48          | 2269           |
|           |           |             | 6638         | -132            | -6              | 0            | 0               | -138         | 6500           |
| 2         | 62784     | 855         | 8556         | -171            | -8              |              |                 | -179         | 8377           |
| 2         | 62784     | H71         | 6691         | -134            | -6              |              |                 | -140         | 6551           |
| 2         | 62784     | T40         | 11403        | -228            | -11             | -24          |                 | -263         | 11140          |
| 2         | 62784     | T41         | 4285         | -86             | -4              |              |                 | -90          | 4195           |
| 2         | 62784     | T42         | 5541         | -111            | -5              |              |                 | -116         | 5425           |
| 2         | 62784     | T45         | 2422         | -48             | -2              |              |                 | -50          | 2372           |
|           |           |             | 38898        | -778            | -36             | -24          | 0               | -838         | 38060          |
| 2         | 62785     | 790         | 3107         | -62             | -3              |              |                 | -65          | 3042           |
| 2         | 62785     | 791         | 6421         | -128            | -6              |              |                 | -134         | 6287           |
|           |           |             | 9528         | -190            | -9              | 0            | 0               | -199         | 9329           |
| 2         | 62786     | 283         | 1665         | -33             | -2              |              |                 | -35          | 1630           |

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|           |                   |             | A             | B               | C               | D                                     | E               | F             | G              |
|-----------|-------------------|-------------|---------------|-----------------|-----------------|---------------------------------------|-----------------|---------------|----------------|
|           |                   |             |               |                 |                 |                                       |                 | (B+C+D+E)     | (A-F)          |
|           |                   |             |               |                 |                 |                                       |                 |               |                |
|           |                   |             | FY 97         |                 |                 |                                       | Sec 8037        | Tot Adj to    | FY 97          |
|           |                   |             | Approp        |                 |                 |                                       | Consulting      | Approp        | Column         |
| <u>BA</u> | <u>PE</u>         | <u>Proj</u> | <u>Value</u>  | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u>                          | <u>Services</u> | <u>Value</u>  | <u>on RDDS</u> |
| 2         | 62786             | C60         | 3277          | -66             | -3              |                                       |                 | -69           | 3208           |
| 2         | 62786             | J10         | 3000          | -60             | -3              |                                       |                 | -63           | 2937           |
| 2         | 62786             | H98         | 9464          | -189            | -9              | -13                                   | -8              | -219          | 9245           |
| 2         | 62786             | H99         | 4402          | -88             | -4              | -8                                    | -3              | -103          | 4299           |
|           |                   |             | 21808         | -436            | -21             | -21                                   | -11             | -489          | 21319          |
| 2         | 62787             | 825         | 514           | -10             | 0               |                                       |                 | -10           | 504            |
| 2         | 62787             | 870         | 29843         | -597            | -28             |                                       |                 | -1044         | 28799          |
| 2         | 62787             | 873         | 2931          | -59             | -3              |                                       |                 | -62           | 2869           |
| 2         | 62787             | 874         | 11415         | -228            | -11             |                                       |                 | -239          | 11176          |
| 2         | 62787             | 878         | 7294          | -146            | -7              |                                       |                 | -153          | 7141           |
| 2         | 62787             | 879         | 8693          | -174            | -8              |                                       |                 | -182          | 8511           |
| 2         | 62787             | 839         | 2300          | -46             | -2              |                                       |                 | -48           | 2252           |
| 2         | 62787             | 842         | 1000          | -20             | -1              |                                       |                 | -21           | 979            |
| 2         | 62787             | 844         | 20000         | -400            | -19             | TRANSFERRED TO DEFENSE HEALTH PROGRAM |                 |               |                |
| 2         | 62787             | 843         | 3500          | -70             | -3              |                                       |                 | -73           | 3427           |
| 2         | 62787             | 841         | 2500          | -50             | -2              |                                       |                 | -52           | 2448           |
| 2         | 62787             | 838         | 25000         | -500            | -23             |                                       |                 | -523          | 24477          |
| 2         | 62787             | 863         | 2000          | -40             | -2              |                                       |                 | -42           | 1958           |
| 2         | 62787             | 845         | 10000         | -200            | -9              |                                       |                 | -209          | 9791           |
|           |                   |             | 126990        | -2540           | -118            | 0                                     | 0               | -2658         | 104332         |
| 2         | 62789             | 880         | 2226          | -45             | -2              |                                       |                 | -47           | 2179           |
|           |                   |             | 2226          | -45             | -2              | 0                                     | 0               | -47           | 2179           |
|           |                   |             |               |                 |                 |                                       |                 |               |                |
|           | <b>TOTAL BA 2</b> |             | <b>584081</b> | <b>-11680</b>   | <b>-549</b>     | <b>-183</b>                           | <b>-111</b>     | <b>-12523</b> | <b>551558</b>  |
| 3         | 63001             | 242         | 1249          | -25             | -1              |                                       |                 | -26           | 1223           |
| 3         | 63001             | 543         | 3097          | -62             | -3              |                                       |                 | -65           | 3032           |
| 3         | 63001             | 594         | 445           | -9              | 0               |                                       |                 | -9            | 436            |
| 3         | 63001             | C07         | 1891          | -38             | -2              |                                       |                 | -40           | 1851           |
| 3         | 63001             | J28         | 251           | -5              | 0               |                                       |                 | -5            | 246            |

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|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 3         | 63001     | J50         | 16277         | -326            | -15             |              |                   | -341              | 15936          |
|           |           |             | 23210         | -465            | -21             | 0            | 0                 | -486              | 22724          |
| 3         | 63002     | 806         | 100000        | -2000           | -94             |              |                   | -2094             | 97906          |
| 3         | 63002     | 810         | 9228          | -185            | -9              |              |                   | -194              | 9034           |
| 3         | 63002     | 804         | 45000         | -900            | -42             |              |                   | -942              | 44058          |
| 3         | 63002     | 819         | 2400          | -48             | -2              |              |                   | -50               | 2350           |
| 3         | 63002     | 893         | 12000         | -240            | -11             |              |                   | -251              | 11749          |
| 3         | 63002     | 813         | 500           | -10             | 0               |              |                   | -10               | 490            |
| 3         | 63002     | 818         | 3500          | -70             | -3              |              |                   | -73               | 3427           |
| 3         | 63002     | 817         | 3000          | -60             | -3              |              |                   | -63               | 2937           |
| 3         | 63002     | 816         | 6000          | -120            | -6              |              |                   | -126              | 5874           |
| 3         | 63002     | 815         | 6000          | -120            | -6              |              |                   | -126              | 5874           |
| 3         | 63002     | 887         | 7500          | -150            | -7              |              |                   | -157              | 7343           |
| 3         | 63002     | 814         | 8000          | -160            | -8              |              |                   | -168              | 7832           |
| 3         | 63002     | 840         | 2373          | -47             | -2              |              |                   | -49               | 2324           |
|           |           |             | 205501        | -4110           | -193            | 0            | 0                 | -4303             | 201198         |
| 3         | 63003     | 313         | 3527          | -71             | -3              |              |                   | -74               | 3453           |
| 3         | 63003     | 391         | 5040          | -101            | -5              |              |                   | -106              | 4934           |
| 3         | 63003     | 436         | 24647         | -493            | -23             |              | -109              | -625              | 24022          |
| 3         | 63003     | 447         | 7780          | -156            | -7              |              |                   | -163              | 7617           |
| 3         | 63003     | A38         | 15000         | -300            | -14             |              |                   | -314              | 14686          |
| 3         | 63003     | B38         | 1000          | -20             | -1              |              |                   | -21               | 979            |
| 3         | 63003     | B97         | 484           | -10             | 0               |              |                   | -10               | 474            |
|           |           |             | 57478         | -1151           | -53             | 0            | -109              | -1313             | 56165          |
| 3         | 63004     | 232         | 5772          | -115            | -5              |              |                   | -120              | 5652           |
| 3         | 63004     | 43A         | 21809         | -436            | -20             |              |                   | -456              | 21353          |
| 3         | 63004     | L95         | 2178          | -44             | -2              | -15          |                   | -61               | 2117           |
|           |           |             | 29759         | -595            | -27             | -15          | 0                 | -637              | 29122          |

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|           |           |             | A             | B               | C               | D            | E                 | F                 | G              |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | (B+C+D+E)         | (A-F)          |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 3         | 63005     | 221         | 4758          | -95             | -4              |              |                   | -99               | 4659           |
| 3         | 63005     | 440         | 13507         | -270            | -13             |              | -123              | -406              | 13101          |
| 3         | 63005     | 441         | 4203          | -84             | -4              |              |                   | -88               | 4115           |
| 3         | 63005     | 497         | 1818          | -36             | -2              |              |                   | -38               | 1780           |
| 3         | 63005     | 502         | 2000          | -40             | -2              |              |                   | -42               | 1958           |
| 3         | 63005     | C62         | 3266          | -65             | -3              |              |                   | -68               | 3198           |
|           |           |             | 29552         | -590            | -28             | 0            | -123              | -741              | 28811          |
| 3         | 63006     | 247         | 7427          | -149            | -7              |              |                   | -156              | 7271           |
| 3         | 63006     | 257         | 11981         | -240            | -11             | -110         |                   | -361              | 11620          |
| 3         | 63006     | 592         | 3712          | -74             | -3              |              |                   | -77               | 3635           |
| 3         | 63006     | 596         | 5000          | -100            | -5              |              |                   | -105              | 4895           |
| 3         | 63006     | 597         | 2000          | -40             | -2              |              |                   | -42               | 1958           |
|           |           |             | 30120         | -603            | -28             | -110         | 0                 | -741              | 29379          |
| 3         | 63007     | 792         | 1418          | -28             | -1              |              |                   | -29               | 1389           |
| 3         | 63007     | 793         | 3082          | -62             | -3              |              |                   | -65               | 3017           |
|           |           |             | 4500          | -90             | -4              | 0            | 0                 | -94               | 4406           |
| 3         | 63009     | B18         | 17176         | -344            | -16             | -25          |                   | -385              | 16791          |
|           |           |             | 17176         | -344            | -16             | -25          | 0                 | -385              | 16791          |
| 3         | 63013     | C25         | 3335          | -67             | -3              |              |                   | -70               | 3265           |
|           |           |             | 3335          | -67             | -3              | 0            | 0                 | -70               | 3265           |
| 3         | 63017     | B69         | 8625          | -172            | -8              |              |                   | -180              | 8445           |
|           |           |             | 8625          | -172            | -8              | 0            | 0                 | -180              | 8445           |
| 3         | 63020     | B77         | 5078          | -102            | -5              |              |                   | -107              | 4971           |
|           |           |             | 5078          | -102            | -5              | 0            | 0                 | -107              | 4971           |
| 3         | 63105     | H29         | 17919         | -358            | -17             |              |                   | -375              | 17544          |

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**FY97 COLUMN OF FY98/99 PRES BUD**

|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
|           |           |             | 17919         | -358            | -17             | 0            | 0                 | -375              | 17544          |
| 3         | 63238     | 177         | 14446         | -289            | -14             | -22          | -124              | -449              | 13997          |
| 3         | 63238     | 546         | 8212          | -164            | -8              |              | -28               | -200              | 8012           |
|           |           |             | 22658         | -453            | -22             | -22          | -152              | -649              | 22009          |
| 3         | 63270     | K15         | 2913          | -58             | -3              |              |                   | -61               | 2852           |
| 3         | 63270     | K16         | 3881          | -78             | -4              |              |                   | -82               | 3799           |
|           |           |             | 6794          | -136            | -7              | 0            | 0                 | -143              | 6651           |
| 3         | 63313     | 206         | 1             | 0               | 0               |              |                   | 0                 | 1              |
| 3         | 63313     | 703         | 9000          | -180            | -8              |              |                   | -188              | 8812           |
| 3         | 63313     | 263         | 9745          | -195            | -9              |              |                   | -204              | 9541           |
| 3         | 63313     | 380         | 13515         | -270            | -13             |              |                   | -283              | 13232          |
| 3         | 63313     | 387         | 639           | -13             | -1              |              |                   | -14               | 625            |
| 3         | 63313     | 486         | 7849          | -157            | -7              | -29          |                   | -193              | 7656           |
| 3         | 63313     | 493         | 24245         | -485            | -23             |              |                   | -508              | 23737          |
| 3         | 63313     | 496         | 37042         | -741            | -35             | -18          | -34               | -828              | 36214          |
| 3         | 63313     | 550         | 1             | 0               | 0               |              |                   | 0                 | 1              |
|           |           |             | 102037        | -2041           | -96             | -47          | -34               | -2218             | 99819          |
| 3         | 63322     | B92         | 8851          | -177            | -8              |              | -15               | -200              | 8651           |
|           |           |             | 8851          | -177            | -8              | 0            | -15               | -200              | 8651           |
| 3         | 63606     | 608         | 23296         | -466            | -22             | -67          | -7                | -562              | 22734          |
| 3         | 63606     | 624         | 5000          | -100            | -5              |              |                   | -105              | 4895           |
|           |           |             | 28296         | -566            | -27             | -67          | -7                | -667              | 27629          |
| 3         | 63607     | 627         | 8243          | -165            | -8              |              |                   | -173              | 8070           |
| 3         | 63607     | 664         | 1000          | -20             | -1              |              |                   | -21               | 979            |
|           |           |             | 9243          | -185            | -9              | 0            | 0                 | -194              | 9049           |

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|           |                   |             | A             | B               | C               | D            | E                 | F                 | G              |
|-----------|-------------------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |                   |             |               |                 |                 |              |                   | (B+C+D+E)         | (A-F)          |
|           |                   |             |               |                 |                 |              |                   |                   |                |
|           |                   |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |                   |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b>         | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 3         | 63654             | 460         | 10000         | -200            | -9              |              |                   | -209              | 9791           |
|           |                   |             | 10000         | -200            | -9              | 0            | 0                 | -209              | 9791           |
| 3         | 63710             | C63         | 2224          | -44             | -2              |              |                   | -46               | 2178           |
| 3         | 63710             | K70         | 11425         | -228            | -11             |              |                   | -239              | 11186          |
| 3         | 63710             | K86         | 5566          | -111            | -5              |              |                   | -116              | 5450           |
| 3         | 63710             | K87         | 11182         | -224            | -11             |              |                   | -235              | 10947          |
|           |                   |             | 30397         | -607            | -29             | 0            | 0                 | -636              | 29761          |
| 3         | 63734             | T08         | 1456          | -29             | -1              |              |                   | -30               | 1426           |
| 3         | 63734             | T10         | 9585          | -192            | -9              |              |                   | -201              | 9384           |
| 3         | 63734             | T12         | 9623          | -192            | -9              | -19          |                   | -220              | 9403           |
|           |                   |             | 20664         | -413            | -19             | -19          | 0                 | -451              | 20213          |
| 3         | 63772             | 101         | 13988         | -280            | -13             | -265         |                   | -558              | 13430          |
| 3         | 63772             | 243         | 975           | -19             | -1              |              |                   | -20               | 955            |
| 3         | 63772             | 281         | 7136          | -143            | -7              | -51          | -38               | -239              | 6897           |
|           |                   |             | 22099         | -442            | -21             | -316         | -38               | -817              | 21282          |
|           | <b>TOTAL BA 3</b> |             | <b>693292</b> | <b>-13867</b>   | <b>-650</b>     | <b>-621</b>  | <b>-478</b>       | <b>-15616</b>     | <b>677676</b>  |
| 4         | 63018             | B89         | 2409          | -48             | -2              | -30          |                   | -80               | 2329           |
|           |                   |             | 2409          | -48             | -2              | -30          | 0                 | -80               | 2329           |
| 4         | 63308             | 990         | 2884          | -58             | -3              |              |                   | -61               | 2823           |
| 4         | 63308             | 989         | 45000         | -900            | -42             |              |                   | -942              | 44058          |
| 4         | 63308             | 997         | 20000         | -400            | -19             |              |                   | -419              | 19581          |
|           |                   |             | 67884         | -1358           | -64             | 0            | 0                 | -1422             | 66462          |
| 4         | 63619             | 606         | 28464         | -569            | -27             |              | -8                | -604              | 27860          |
|           |                   |             | 28464         | -569            | -27             | 0            | -8                | -604              | 27860          |

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|           |           |             | A             | B               | C               | D            | E                 | F                 | G              |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | (B+C+D+E)         | (A-F)          |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 4         | 63627     | E79         | 6380          | -128            | -6              |              |                   | -134              | 6246           |
|           |           |             | 6380          | -128            | -6              | 0            | 0                 | -134              | 6246           |
| 4         | 63639     | 643         | 46561         | -931            | -44             |              | -5                | -980              | 45581          |
| 4         | 63639     | 656         | 18160         | -363            | -17             | -7           |                   | -387              | 17773          |
|           |           |             | 64721         | -1294           | -61             | -7           | -5                | -1367             | 63354          |
| 4         | 63640     | B91         | 8500          | -170            | -8              |              |                   | -178              | 8322           |
|           |           |             | 8500          | -170            | -8              | 0            | 0                 | -178              | 8322           |
| 4         | 63645     | Q19         | 8000          | -160            | -8              | -29          |                   | -197              | 7803           |
|           |           |             | 8000          | -160            | -8              | -29          | 0                 | -197              | 7803           |
| 4         | 63653     | B99         | 11639         | -233            | -11             |              |                   | -244              | 11395          |
|           |           |             | 11639         | -233            | -11             | 0            | 0                 | -244              | 11395          |
| 4         | 63713     | 2QT         | 3653          | -73             | -3              |              | -39               | -115              | 3538           |
| 4         | 63713     | 370         | 20169         | -403            | -19             |              | -2                | -424              | 19745          |
|           |           |             | 23822         | -476            | -22             | 0            | -41               | -539              | 23283          |
| 4         | 63745     | 535         | 4025          | -80             | -4              |              |                   | -84               | 3941           |
|           |           |             | 4025          | -80             | -4              | 0            | 0                 | -84               | 3941           |
| 4         | 63747     | 610         | 1946          | -39             | -2              |              |                   | -41               | 1905           |
| 4         | 63747     | 669         | 3418          | -68             | -3              |              |                   | -71               | 3347           |
| 4         | 63747     | C09         | 1316          | -26             | -1              |              |                   | -27               | 1289           |
|           |           |             | 6680          | -133            | -6              | 0            | 0                 | -139              | 6541           |
| 4         | 63766     | 907         | 26060         | -521            | -24             | -17          | -144              | -706              | 25354          |
|           |           |             | 26060         | -521            | -24             | -17          | -144              | -706              | 25354          |
| 4         | 63774     | 131         | 2829          | -57             | -3              |              |                   | -60               | 2769           |

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|           |           |             | A            | B               | C               | D            | E               | F            | G              |
|-----------|-----------|-------------|--------------|-----------------|-----------------|--------------|-----------------|--------------|----------------|
|           |           |             |              |                 |                 |              |                 | (B+C+D+E)    | (A-F)          |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             | FY 97        |                 |                 |              | Sec 8037        | Tot Adj to   | FY 97          |
|           |           |             | Approp       |                 |                 |              | Consulting      | Approp       | Column         |
| <u>BA</u> | <u>PE</u> | <u>Proj</u> | <u>Value</u> | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u> | <u>on RDDS</u> |
|           |           |             | 2829         | -57             | -3              | 0            | 0               | -60          | 2769           |
| 4         | 63790     | 691         | 9963         | -199            | -9              |              |                 | -208         | 9755           |
|           |           |             | 9963         | -199            | -9              | 0            | 0               | -208         | 9755           |
| 4         | 63801     | B32         | 2228         | -45             | -2              |              |                 | -47          | 2181           |
| 4         | 63801     | B33         | 2053         | -41             | -2              |              |                 | -43          | 2010           |
| 4         | 63801     | B45         | 9104         | -182            | -9              |              |                 | -191         | 8913           |
|           |           |             | 13385        | -268            | -13             | 0            | 0               | -281         | 13104          |
| 4         | 63804     | 266         | 1444         | -29             | -1              |              |                 | -30          | 1414           |
| 4         | 63804     | 428         | 3951         | -79             | -4              |              |                 | -83          | 3868           |
| 4         | 63804     | G10         | 132          | -3              | 0               |              |                 | -3           | 129            |
| 4         | 63804     | G11         | 217          | -4              | 0               |              |                 | -4           | 213            |
| 4         | 63804     | G14         | 88           | -2              | 0               |              |                 | -2           | 86             |
| 4         | 63804     | K39         | 869          | -17             | -1              |              |                 | -18          | 851            |
| 4         | 63804     | K41         | 891          | -18             | -1              |              |                 | -19          | 872            |
|           |           |             | 7592         | -152            | -7              | 0            | 0               | -159         | 7433           |
| 4         | 63805     | 091         | 11119        | -222            | -10             | -3           |                 | -235         | 10884          |
| 4         | 63805     | 246         | 2021         | -40             | -2              | -61          |                 | -103         | 1918           |
|           |           |             | 13140        | -262            | -12             | -64          | 0               | -338         | 12802          |
| 4         | 63807     | 808         | 3835         | -77             | -4              |              |                 | -81          | 3754           |
| 4         | 63807     | 811         | 2636         | -53             | -2              |              |                 | -55          | 2581           |
| 4         | 63807     | 836         | 2905         | -58             | -3              |              |                 | -61          | 2844           |
| 4         | 63807     | 837         | 835          | -17             | -1              |              |                 | -18          | 817            |
|           |           |             | 10211        | -205            | -10             | 0            | 0               | -215         | 9996           |
| 4         | 63851     | C75         | 3124         | -62             | -3              | -48          | -10             | -123         | 3001           |
|           |           |             | 3124         | -62             | -3              | -48          | -10             | -123         | 3001           |

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|           |                   |             | A             | B               | C               | D            | E                 | F                 | G              |
|-----------|-------------------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |                   |             |               |                 |                 |              |                   | (B+C+D+E)         | (A-F)          |
|           |                   |             |               |                 |                 |              |                   |                   |                |
|           |                   |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |                   |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b>         | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 4         | 63854             | 505         | 240916        | -4818           | -226            |              | -77               | -5121             | 235795         |
| 4         | 63854             | C68         | 2855          | -57             | -3              |              |                   | -60               | 2795           |
|           |                   |             | 243771        | -4875           | -229            | 0            | -77               | -5181             | 238590         |
| 4         | 63856             | 389         | 8080          | -162            | -8              |              |                   | -170              | 7910           |
|           |                   |             | 8080          | -162            | -8              | 0            | 0                 | -170              | 7910           |
|           | <b>TOTAL BA 4</b> |             | <b>570679</b> | <b>-11412</b>   | <b>-537</b>     | <b>-195</b>  | <b>-285</b>       | <b>-12429</b>     | <b>558250</b>  |
| 5         | 64201             | C97         | 15008         | -300            | -14             |              |                   | -314              | 14694          |
|           |                   |             | 15008         | -300            | -14             | 0            | 0                 | -314              | 14694          |
| 5         | 64220             | 538         | 1154          | -23             | -1              |              |                   | -24               | 1130           |
|           |                   |             | 1154          | -23             | -1              | 0            | 0                 | -24               | 1130           |
| 5         | 64223             | 327         | 296528        | -5930           | -278            |              | -130              | -6338             | 290190         |
| 5         | 64223             | C72         | 42116         | -842            | -40             |              |                   | -882              | 41234          |
|           |                   |             | 338644        | -6772           | -318            | 0            | -130              | -7220             | 331424         |
| 5         | 64270             | 665         | 44579         | -892            | -42             |              |                   | -934              | 43645          |
| 5         | 64270             | L12         | 16414         | -328            | -15             | -6           |                   | -349              | 16065          |
| 5         | 64270             | L15         | 3845          | -77             | -4              |              |                   | -81               | 3764           |
| 5         | 64270             | L16         | 1288          | -26             | -1              |              |                   | -27               | 1261           |
| 5         | 64270             | L18         | 9348          | -187            | -9              |              | -1                | -197              | 9151           |
|           |                   |             | 75474         | -1510           | -71             | -6           | -1                | -1588             | 73886          |
| 5         | 64321             | 2FT         | 3767          | -75             | -4              |              | -40               | -119              | 3648           |
| 5         | 64321             | B19         | 36433         | -729            | -34             | -10          |                   | -773              | 35660          |
|           |                   |             | 40200         | -804            | -38             | -10          | -40               | -892              | 39308          |
| 5         | 64325             | E18         | 5596          | -112            | -5              |              |                   | -117              | 5479           |
|           |                   |             | 5596          | -112            | -5              | 0            | 0                 | -117              | 5479           |

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|           |           |             | A            | B               | C               | D            | E               | F            | G              |
|-----------|-----------|-------------|--------------|-----------------|-----------------|--------------|-----------------|--------------|----------------|
|           |           |             |              |                 |                 |              |                 | (B+C+D+E)    | (A-F)          |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             | FY 97        |                 |                 |              | Sec 8037        | Tot Adj to   | FY 97          |
|           |           |             | Approp       |                 |                 |              | Consulting      | Approp       | Column         |
| <u>BA</u> | <u>PE</u> | <u>Proj</u> | <u>Value</u> | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u> | <u>on RDDS</u> |
| 5         | 64328     | C71         | 1561         | -31             | -1              |              | -5              | -37          | 1524           |
|           |           |             | 1561         | -31             | -1              | 0            | -5              | -37          | 1524           |
| 5         | 64604     | H07         | 6000         | -120            | -6              |              |                 | -126         | 5874           |
|           |           |             | 6000         | -120            | -6              | 0            | 0               | -126         | 5874           |
| 5         | 64611     | 499         | 6143         | -123            | -6              |              |                 | -129         | 6014           |
|           |           |             | 6143         | -123            | -6              | 0            | 0               | -129         | 6014           |
| 5         | 64619     | 088         | 26909        | -538            | -25             | -41          | -17             | -621         | 26288          |
|           |           |             | 26909        | -538            | -25             | -41          | -17             | -621         | 26288          |
| 5         | 64622     | 659         | 2000         | -40             | -2              |              |                 | -42          | 1958           |
|           |           |             | 2000         | -40             | -2              | 0            | 0               | -42          | 1958           |
| 5         | 64633     | 586         | 7549         | -151            | -7              |              | -14             | -172         | 7377           |
|           |           |             | 7549         | -151            | -7              | 0            | -14             | -172         | 7377           |
| 5         | 64640     | G27         | 7899         | -158            | -7              |              |                 | -165         | 7734           |
|           |           |             | 7899         | -158            | -7              | 0            | 0               | -165         | 7734           |
| 5         | 64641     | E47         | 2884         | -58             | -3              |              |                 | -61          | 2823           |
|           |           |             | 2884         | -58             | -3              | 0            | 0               | -61          | 2823           |
| 5         | 64642     | E40         | 3000         | -60             | -3              |              |                 | -63          | 2937           |
|           |           |             | 3000         | -60             | -3              | 0            | 0               | -63          | 2937           |
| 5         | 64645     | 175         | 6726         | -135            | -6              |              |                 | -141         | 6585           |
|           |           |             | 6726         | -135            | -6              | 0            | 0               | -141         | 6585           |
| 5         | 64649     | G25         | 34837        | -697            | -33             |              | -5              | -735         | 34102          |

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|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 5         | 64649     | G26         | 12873         | -257            | -12             |              | -1                | -270              | 12603          |
|           |           |             | 47710         | -954            | -45             | 0            | -6                | -1005             | 46705          |
| 5         | 64710     | L69         | 18443         | -369            | -17             | -8           | -13               | -407              | 18036          |
| 5         | 64710     | L70         | 9482          | -190            | -9              |              |                   | -199              | 9283           |
| 5         | 64710     | L74         | 7712          | -154            | -7              |              |                   | -161              | 7551           |
|           |           |             | 35637         | -713            | -33             | -8           | -13               | -767              | 34870          |
| 5         | 64713     | 548         | 809           | -16             | -1              |              |                   | -17               | 792            |
| 5         | 64713     | 667         | 48917         | -978            | -46             |              |                   | -1024             | 47893          |
| 5         | 64713     | 668         | 21598         | -432            | -20             |              |                   | -452              | 21146          |
| 5         | 64713     | C40         | 1784          | -36             | -2              |              |                   | -38               | 1746           |
| 5         | 64713     | L40         | 4955          | -99             | -5              |              |                   | -104              | 4851           |
|           |           |             | 78063         | -1561           | -74             | 0            | 0                 | -1635             | 76428          |
| 5         | 64715     | 241         | 36752         | -735            | -35             | -31          |                   | -801              | 35951          |
| 5         | 64715     | 396         | 2781          | -56             | -3              |              |                   | -59               | 2722           |
| 5         | 64715     | 573         | 10332         | -207            | -10             |              |                   | -217              | 10115          |
|           |           |             | 49865         | -998            | -48             | -31          | 0                 | -1077             | 48788          |
| 5         | 64716     | 579         | 7369          | -147            | -7              | -50          | -21               | -225              | 7144           |
|           |           |             | 7369          | -147            | -7              | -50          | -21               | -225              | 7144           |
| 5         | 64739     | 702         | 4867          | -97             | -5              |              |                   | -102              | 4765           |
|           |           |             | 4867          | -97             | -5              | 0            | 0                 | -102              | 4765           |
| 5         | 64741     | 126         | 20516         | -410            | -19             | -9           | -47               | -485              | 20031          |
|           |           |             | 20516         | -410            | -19             | -9           | -47               | -485              | 20031          |
| 5         | 64746     | L59         | 9793          | -196            | -9              | -10          | -3                | -218              | 9575           |
|           |           |             | 9793          | -196            | -9              | -10          | -3                | -218              | 9575           |

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|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 5         | 64760     | C73         | 10248         | -205            | -10             |              |                   | -215              | 10033          |
| 5         | 64760     | C74         | 2632          | -53             | -2              |              |                   | -55               | 2577           |
| 5         | 64760     | C77         | 3086          | -62             | -3              |              |                   | -65               | 3021           |
|           |           |             | 15966         | -320            | -15             | 0            | 0                 | -335              | 15631          |
| 5         | 64766     | 909         | 15758         | -315            | -15             | -136         | -57               | -523              | 15235          |
|           |           |             | 15758         | -315            | -15             | -136         | -57               | -523              | 15235          |
| 5         | 64768     | 2NT         | 5             | 0               | 0               |              |                   | 0                 | 5              |
| 5         | 64768     | 641         | 68622         | -1372           | -64             |              |                   | -1436             | 67186          |
| 5         | 64768     | 687         | 19221         | -384            | -18             |              |                   | -402              | 18819          |
| 5         | 64768     | 688         | 77559         | -1551           | -73             |              | -129              | -1753             | 75806          |
|           |           |             | 165407        | -3307           | -155            | 0            | -129              | -3591             | 161816         |
| 5         | 64770     | 202         | 9857          | -197            | -9              | -12          | -15               | -233              | 9624           |
|           |           |             | 9857          | -197            | -9              | -12          | -15               | -233              | 9624           |
| 5         | 64778     | 168         | 437           | -9              | 0               |              |                   | -9                | 428            |
|           |           |             | 437           | -9              | 0               | 0            | 0                 | -9                | 428            |
| 5         | 64780     | 571         | 26713         | -534            | -25             | -44          |                   | -603              | 26110          |
|           |           |             | 26713         | -534            | -25             | -44          | 0                 | -603              | 26110          |
| 5         | 64801     | C45         | 5518          | -110            | -5              |              |                   | -115              | 5403           |
|           |           |             | 5518          | -110            | -5              | 0            | 0                 | -115              | 5403           |
| 5         | 64802     | 284         | 14108         | -282            | -13             |              |                   | -295              | 13813          |
| 5         | 64802     | AS1         | 1600          | -32             | -2              |              |                   | -34               | 1566           |
| 5         | 64802     | 531         | 5176          | -104            | -5              |              |                   | -109              | 5067           |
| 5         | 64802     | 712         | 3284          | -66             | -3              |              |                   | -69               | 3215           |
|           |           |             | 24168         | -484            | -23             | 0            | 0                 | -507              | 23661          |

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|           |           |             | A            | B               | C               | D            | E               | F            | G              |
|-----------|-----------|-------------|--------------|-----------------|-----------------|--------------|-----------------|--------------|----------------|
|           |           |             |              |                 |                 |              |                 | (B+C+D+E)    | (A-F)          |
|           |           |             | FY 97        |                 |                 |              | Sec 8037        | Tot Adj to   | FY 97          |
|           |           |             | Approp       |                 |                 |              | Consulting      | Approp       | Column         |
| <u>BA</u> | <u>PE</u> | <u>Proj</u> | <u>Value</u> | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u> | <u>on RDDS</u> |
| 5         | 64804     | 194         | 2230         | -45             | -2              |              |                 | -47          | 2183           |
| 5         | 64804     | 279         | 1444         | -29             | -1              |              |                 | -30          | 1414           |
| 5         | 64804     | 429         | 3261         | -65             | -3              |              |                 | -68          | 3193           |
| 5         | 64804     | H01         | 9635         | -193            | -9              |              |                 | -202         | 9433           |
| 5         | 64804     | H14         | 88           | -2              | 0               |              |                 | -2           | 86             |
| 5         | 64804     | L39         | 1677         | -34             | -2              |              |                 | -36          | 1641           |
| 5         | 64804     | L41         | 1033         | -21             | -1              |              |                 | -22          | 1011           |
| 5         | 64804     | L42         | 962          | -19             | -1              |              |                 | -20          | 942            |
|           |           |             | 20330        | -408            | -19             | 0            | 0               | -427         | 19903          |
| 5         | 64805     | 097         | 1715         | -34             | -2              | -19          |                 | -55          | 1660           |
| 5         | 64805     | 098         | 569          | -11             | -1              | -15          |                 | -27          | 542            |
| 5         | 64805     | 282         | 7031         | -141            | -7              |              |                 | -148         | 6883           |
| 5         | 64805     | 485         | 481          | -10             | 0               |              |                 | -10          | 471            |
|           |           |             | 9796         | -196            | -10             | -34          | 0               | -240         | 9556           |
| 5         | 64807     | 812         | 193          | -4              | 0               |              |                 | -4           | 189            |
| 5         | 64807     | 832         | 1695         | -34             | -2              |              |                 | -36          | 1659           |
| 5         | 64807     | 834         | 884          | -18             | -1              |              |                 | -19          | 865            |
| 5         | 64807     | 849         | 2022         | -40             | -2              |              |                 | -42          | 1980           |
|           |           |             | 4794         | -96             | -5              | 0            | 0               | -101         | 4693           |
| 5         | 64808     | 016         | 5499         | -110            | -5              |              |                 | -115         | 5384           |
| 5         | 64808     | 415         | 2232         | -45             | -2              | -5           | -8              | -60          | 2172           |
|           |           |             | 7731         | -155            | -7              | -5           | -8              | -175         | 7556           |
| 5         | 64814     | 2ST         | 309          | -6              | 0               |              | -3              | -9           | 300            |
| 5         | 64814     | 644         | 9840         | -197            | -9              |              |                 | -206         | 9634           |
|           |           |             | 10149        | -203            | -9              | 0            | -3              | -215         | 9934           |
| 5         | 64816     | C87         | 5872         | -117            | -6              |              |                 | -123         | 5749           |
| 5         | 64816     | C31         | 5000         | -100            | -5              |              |                 | -105         | 4895           |

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|           |                   |             | A              | B               | C               | D            | E               | F             | G              |
|-----------|-------------------|-------------|----------------|-----------------|-----------------|--------------|-----------------|---------------|----------------|
|           |                   |             |                |                 |                 |              |                 | (B+C+D+E)     | (A-F)          |
|           |                   |             | FY 97          | Sec 8037        |                 |              |                 | Tot Adj to    | FY 97          |
|           |                   |             | Approp         |                 |                 |              | Consulting      | Approp        | Column         |
| <u>BA</u> | <u>PE</u>         | <u>Proj</u> | <u>Value</u>   | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u>  | <u>on RDDS</u> |
|           |                   |             | 10872          | -217            | -11             | 0            | 0               | -228          | 10644          |
| 5         | 64817             | 482         | 13886          | -278            | -13             |              | -20             | -311          | 13575          |
| 5         | 64817             | 901         | 2897           | -58             | -3              |              |                 | -61           | 2836           |
|           |                   |             | 16783          | -336            | -16             | 0            | -20             | -372          | 16411          |
| 5         | 64818             | 323         | 7784           | -156            | -7              |              |                 | -163          | 7621           |
| 5         | 64818             | C34         | 8645           | -173            | -8              | -290         | -15             | -486          | 8159           |
|           |                   |             | 16429          | -329            | -15             | -290         | -15             | -649          | 15780          |
| 5         | 64823             | L85         | 2551           | -51             | -2              |              | -2              | -55           | 2496           |
|           |                   |             | 2551           | -51             | -2              | 0            | -2              | -55           | 2496           |
| 5         | 64854             | 509         | 3000           | -60             | -3              |              |                 | -63           | 2937           |
|           |                   |             | 3000           | -60             | -3              | 0            | 0               | -63           | 2937           |
|           | <b>TOTAL BA 5</b> |             | <b>1166826</b> | <b>-23338</b>   | <b>-1097</b>    | <b>-686</b>  | <b>-546</b>     | <b>-25667</b> | <b>1141159</b> |
| 6         | 64256             | 976         | 11627          | -233            | -11             |              |                 | -244          | 11383          |
|           |                   |             | 11627          | -233            | -11             | 0            | 0               | -244          | 11383          |
| 6         | 64258             | 238         | 6706           | -134            | -6              | -2           |                 | -142          | 6564           |
| 6         | 64258             | 459         | 3423           | -68             | -3              |              |                 | -71           | 3352           |
|           |                   |             | 10129          | -202            | -9              | -2           | 0               | -213          | 9916           |
| 6         | 64759             | 983         | 2423           | -48             | -2              |              |                 | -50           | 2373           |
| 6         | 64759             | 984         | 32197          | -644            | -30             | -19          |                 | -693          | 31504          |
| 6         | 64759             | 986         | 7105           | -142            | -7              |              |                 | -149          | 6956           |
|           |                   |             | 41725          | -834            | -39             | -19          | 0               | -892          | 40833          |
| 6         | 65103             | 732         | 21763          | -435            | -20             | -200         |                 | -655          | 21108          |
|           |                   |             | 21763          | -435            | -20             | -200         | 0               | -655          | 21108          |

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|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 6         | 65301     | 614         | 146864        | -2937           | -138            |              |                   | -3075             | 143789         |
|           |           |             | 146864        | -2937           | -138            | 0            | 0                 | -3075             | 143789         |
| 6         | 65502     | 770         |               | 0               | 0               |              |                   | 0                 | 0              |
| 6         | 65502     | 771         |               | 0               | 0               |              |                   | 0                 | 0              |
| 6         | 65502     | 802         |               | 0               | 0               |              |                   | 0                 | 0              |
| 6         | 65502     | 860         |               | 0               | 0               |              |                   | 0                 | 0              |
| 6         | 65502     | 861         |               | 0               | 0               |              |                   | 0                 | 0              |
| 6         | 65502     | M40         |               | 0               | 0               |              |                   | 0                 | 0              |
|           |           |             | 0             | 0               | 0               | 0            | 0                 | 0                 | 0              |
| 6         | 65601     | 618         | 12826         | -257            | -12             |              |                   | -269              | 12557          |
| 6         | 65601     | 630         | 4785          | -96             | -4              |              |                   | -100              | 4685           |
| 6         | 65601     | 632         | 1578          | -32             | -1              |              |                   | -33               | 1545           |
| 6         | 65601     | E90         | 17418         | -348            | -16             |              |                   | -364              | 17054          |
| 6         | 65601     | E91         | 35172         | -703            | -33             |              |                   | -736              | 34436          |
| 6         | 65601     | E93         | 61233         | -1225           | -58             | -5           |                   | -1288             | 59945          |
|           |           |             | 133012        | -2661           | -124            | -5           | 0                 | -2790             | 130222         |
| 6         | 65602     | 628         | 22413         | -448            | -21             |              |                   | -469              | 21944          |
|           |           |             | 22413         | -448            | -21             | 0            | 0                 | -469              | 21944          |
| 6         | 65604     | 670         | 4879          | -98             | -5              |              |                   | -103              | 4776           |
| 6         | 65604     | 671         | 5818          | -116            | -5              | -10          |                   | -131              | 5687           |
| 6         | 65604     | 672         | 3739          | -75             | -4              |              |                   | -79               | 3660           |
| 6         | 65604     | 675         | 5027          | -101            | -5              |              |                   | -106              | 4921           |
| 6         | 65604     | 677         | 5337          | -107            | -5              |              |                   | -112              | 5225           |
| 6         | 65604     | 678         | 5729          | -115            | -5              |              |                   | -120              | 5609           |
| 6         | 65604     | 679         | 814           | -16             | -1              |              |                   | -17               | 797            |
|           |           |             | 31343         | -628            | -30             | -10          | 0                 | -668              | 30675          |

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|           |           |             | A            | B               | C               | D            | E               | F            | G              |
|-----------|-----------|-------------|--------------|-----------------|-----------------|--------------|-----------------|--------------|----------------|
|           |           |             |              |                 |                 |              |                 | (B+C+D+E)    | (A-F)          |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             | FY 97        |                 |                 |              | Sec 8037        | Tot Adj to   | FY 97          |
|           |           |             | Approp       |                 |                 |              | Consulting      | Approp       | Column         |
| <u>BA</u> | <u>PE</u> | <u>Proj</u> | <u>Value</u> | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u> | <u>on RDDS</u> |
| 6         | 65605     | E97         | 30667        | -613            | -29             | -51          |                 | -693         | 29974          |
|           |           |             | 30667        | -613            | -29             | -51          | 0               | -693         | 29974          |
| 6         | 65606     | 092         | 2905         | -58             | -3              |              | -4              | -65          | 2840           |
|           |           |             | 2905         | -58             | -3              | 0            | -4              | -65          | 2840           |
| 6         | 65702     | 128         | 6484         | -130            | -6              |              |                 | -136         | 6348           |
|           |           |             | 6484         | -130            | -6              | 0            | 0               | -136         | 6348           |
| 6         | 65706     | 026         | 4258         | -85             | -4              |              |                 | -89          | 4169           |
| 6         | 65706     | 541         | 10170        | -203            | -10             |              |                 | -213         | 9957           |
|           |           |             | 14428        | -288            | -14             | 0            | 0               | -302         | 14126          |
| 6         | 65709     | 650         | 3304         | -66             | -3              |              |                 | -69          | 3235           |
| 6         | 65709     | C28         | 4043         | -81             | -4              |              |                 | -85          | 3958           |
|           |           |             | 7347         | -147            | -7              | 0            | 0               | -154         | 7193           |
| 6         | 65712     | 001         | 21021        | -420            | -20             | -2           | -224            | -666         | 20355          |
| 6         | 65712     | 985         | 10545        | -211            | -10             |              |                 | -221         | 10324          |
| 6         | 65712     | 987         | 4396         | -88             | -4              |              |                 | -92          | 4304           |
| 6         | 65712     | V02         | 14944        | -299            | -14             |              |                 | -313         | 14631          |
|           |           |             | 50906        | -1018           | -48             | -2           | -224            | -1292        | 49614          |
| 6         | 65801     | M02         | 7355         | -147            | -7              |              |                 | -154         | 7201           |
| 6         | 65801     | M15         | 3780         | -76             | -4              |              |                 | -80          | 3700           |
| 6         | 65801     | M16         | 4045         | -81             | -4              |              |                 | -85          | 3960           |
| 6         | 65801     | M42         | 5641         | -113            | -5              |              |                 | -118         | 5523           |
| 6         | 65801     | M43         | 5002         | -100            | -5              |              |                 | -105         | 4897           |
| 6         | 65801     | M44         | 5969         | -119            | -6              |              |                 | -125         | 5844           |
| 6         | 65801     | M45         | 5487         | -110            | -5              | -3           | -1              | -119         | 5368           |
| 6         | 65801     | M46         | 2260         | -45             | -2              |              |                 | -47          | 2213           |
| 6         | 65801     | M47         | 2632         | -53             | -2              |              |                 | -55          | 2577           |

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|           |           |             | <b>A</b>      | <b>B</b>        | <b>C</b>        | <b>D</b>     | <b>E</b>          | <b>F</b>          | <b>G</b>       |
|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 6         | 65801     | M53         | 12565         | -251            | -12             | -85          | -14               | -362              | 12203          |
| 6         | 65801     | M55         | 3179          | -64             | -3              |              |                   | -67               | 3112           |
| 6         | 65801     | M58         | 390           | -8              | 0               |              |                   | -8                | 382            |
| 6         | 65801     | M75         | 2787          | -56             | -3              |              |                   | -59               | 2728           |
|           |           |             | 61092         | -1223           | -58             | -88          | -15               | -1384             | 59708          |
| 6         | 65802     | 798         | 1566          | -31             | -1              |              |                   | -32               | 1534           |
|           |           |             | 1566          | -31             | -1              | 0            | 0                 | -32               | 1534           |
| 6         | 65803     | 720         | 2626          | -53             | -2              |              | -9                | -64               | 2562           |
| 6         | 65803     | 727         | 2870          | -57             | -3              |              | -5                | -65               | 2805           |
| 6         | 65803     | 729         | 2309          | -46             | -2              |              |                   | -48               | 2261           |
| 6         | 65803     | 730         | 3448          | -69             | -3              |              |                   | -72               | 3376           |
| 6         | 65803     | 733         | 2180          | -44             | -2              |              |                   | -46               | 2134           |
| 6         | 65803     | C16         | 2798          | -56             | -3              |              |                   | -59               | 2739           |
| 6         | 65803     | C18         | 690           | -14             | -1              |              |                   | -15               | 675            |
|           |           |             | 16921         | -339            | -16             | 0            | -14               | -369              | 16552          |
| 6         | 65805     | 296         | 682           | -14             | -1              |              |                   | -15               | 667            |
| 6         | 65805     | 857         | 589           | -12             | -1              |              |                   | -13               | 576            |
| 6         | 65805     | F21         | 280           | -6              | 0               |              |                   | -6                | 274            |
| 6         | 65805     | F24         | 1731          | -35             | -2              |              |                   | -37               | 1694           |
|           |           |             | 3282          | -67             | -4              | 0            | 0                 | -71               | 3211           |
| 6         | 65853     | 0CC         | 1498          | -30             | -1              |              |                   | -31               | 1467           |
| 6         | 65853     | 1CC         | 115           | -2              | 0               |              |                   | -2                | 113            |
| 6         | 65853     | 5CC         | 146           | -3              | 0               |              |                   | -3                | 143            |
|           |           |             | 1759          | -35             | -1              | 0            | 0                 | -36               | 1723           |
| 6         | 65854     | 0PP         | 546           | -11             | -1              |              |                   | -12               | 534            |
| 6         | 65854     | 1PP         | 143           | -3              | 0               |              |                   | -3                | 140            |
| 6         | 65854     | 5PP         | 1957          | -39             | -2              |              |                   | -41               | 1916           |

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|           |           |             |               |                 |                 |              |                   | (B+C+D+E)         | (A-F)          |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 6         | 65854     | 7PP         | 799           | -16             | -1              |              |                   | -17               | 782            |
| 6         | 65854     | 8PP         | 10449         | -209            | -10             |              |                   | -219              | 10230          |
|           |           |             | 13894         | -278            | -14             | 0            | 0                 | -292              | 13602          |
| 6         | 65856     | 0VV         | 34856         | -697            | -33             |              |                   | -730              | 34126          |
| 6         | 65856     | 1VV         | 13972         | -279            | -13             |              |                   | -292              | 13680          |
| 6         | 65856     | 4VV         | 1500          | -30             | -1              |              |                   | -31               | 1469           |
| 6         | 65856     | 5VV         | 5083          | -102            | -5              |              |                   | -107              | 4976           |
|           |           |             | 55411         | -1108           | -52             | 0            | 0                 | -1160             | 54251          |
| 6         | 65876     | 0WW         | 2766          | -55             | -3              |              |                   | -58               | 2708           |
| 6         | 65876     | 1WW         | 1062          | -21             | -1              |              |                   | -22               | 1040           |
| 6         | 65876     | 4WW         | 491           | -10             | 0               |              |                   | -10               | 481            |
|           |           |             | 4319          | -86             | -4              | 0            | 0                 | -90               | 4229           |
| 6         | 65878     | 0YY         | 50862         | -1017           | -48             |              |                   | -1065             | 49797          |
| 6         | 65878     | 1YY         | 15807         | -316            | -15             |              |                   | -331              | 15476          |
| 6         | 65878     | 4YY         | 3378          | -68             | -3              |              |                   | -71               | 3307           |
|           |           |             | 70047         | -1401           | -66             | 0            | 0                 | -1467             | 68580          |
| 6         | 65879     | 0UU         | 62918         | -1258           | -59             |              |                   | -1317             | 61601          |
| 6         | 65879     | 1UU         | 24858         | -497            | -23             |              |                   | -520              | 24338          |
| 6         | 65879     | 4UU         | 4614          | -92             | -4              |              |                   | -96               | 4518           |
|           |           |             | 92390         | -1847           | -86             | 0            | 0                 | -1933             | 90457          |
| 6         | 65896     | 0ZZ         | 148139        | -2963           | -138            |              |                   | -3101             | 145038         |
| 6         | 65896     | 1ZZ         | 64068         | -1281           | -60             |              |                   | -1341             | 62727          |
| 6         | 65896     | 4ZZ         | 12442         | -249            | -12             |              |                   | -261              | 12181          |
|           |           |             | 224649        | -4493           | -210            | 0            | 0                 | -4703             | 219946         |
| 6         | 65898     | M65         | 4801          | -96             | -5              |              |                   | -101              | 4700           |
| 6         | 65898     | 831         | 14000         | -280            | -13             |              |                   | -293              | 13707          |

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|                   |           |             |                |                 |                 |              |                 | (B+C+D+E)     | (A-F)          |
|                   |           |             |                |                 |                 |              |                 |               |                |
|                   |           |             | FY 97          |                 |                 | Sec 8037     |                 | Tot Adj to    | FY 97          |
|                   |           |             | Approp         |                 |                 |              | Consulting      | Approp        | Column         |
| <u>BA</u>         | <u>PE</u> | <u>Proj</u> | <u>Value</u>   | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u>  | <u>on RDDS</u> |
|                   |           |             | 18801          | -376            | -18             | 0            | 0               | -394          | 18407          |
| <b>TOTAL BA 6</b> |           |             | <b>1095744</b> | <b>-21916</b>   | <b>-1029</b>    | <b>-377</b>  | <b>-257</b>     | <b>-23579</b> | <b>1072165</b> |
| 7                 | 63778     | 027         | 27038          | -541            | -25             |              | -50             | -616          | 26422          |
| 7                 | 63778     | 050         | 26324          | -526            | -25             |              |                 | -551          | 25773          |
| 7                 | 63778     | 054         | 10909          | -218            | -10             |              |                 | -228          | 10681          |
|                   |           |             | 64271          | -1285           | -60             | 0            | -50             | -1395         | 62876          |
| 7                 | 12419     | E55         | 26940          | -539            | -25             |              |                 | -564          | 26376          |
|                   |           |             | 26940          | -539            | -25             | 0            | 0               | -564          | 26376          |
| 7                 | 23726     | 2ET         | 4933           | -99             | -5              |              | -52             | -156          | 4777           |
| 7                 | 23726     | 322         | 34564          | -691            | -32             | -42          | -64             | -829          | 33735          |
|                   |           |             | 39497          | -790            | -37             | -42          | -116            | -985          | 38512          |
| 7                 | 23735     | 280         | 3116           | -62             | -3              |              |                 | -65           | 3051           |
| 7                 | 23735     | 2TT         | 2079           | -42             | -2              |              | -22             | -66           | 2013           |
| 7                 | 23735     | 2UT         | 1460           | -29             | -1              |              | -15             | -45           | 1415           |
| 7                 | 23735     | 330         | 71246          | -1425           | -67             |              | -5              | -1497         | 69749          |
| 7                 | 23735     | 344         | 18298          | -366            | -17             |              |                 | -383          | 17915          |
| 7                 | 23735     | 371         | 89635          | -1793           | -84             |              | -5              | -1882         | 87753          |
| 7                 | 23735     | 718         | 11900          | -238            | -11             |              |                 | -249          | 11651          |
| 7                 | 23735     | C64         | 13562          | -271            | -13             |              | -9              | -293          | 13269          |
|                   |           |             | 211296         | -4226           | -198            | 0            | -56             | -4480         | 206816         |
| 7                 | 23740     | 2HT         | 3895           | -78             | -4              |              | -41             | -123          | 3772           |
| 7                 | 23740     | 484         | 25187          | -504            | -24             | -491         | -52             | -1071         | 24116          |
|                   |           |             | 29082          | -582            | -28             | -491         | -93             | -1194         | 27888          |
| 7                 | 23744     | 430         | 17914          | -358            | -17             |              |                 | -375          | 17539          |
| 7                 | 23744     | 504         | 250            | -5              | 0               |              |                 | -5            | 245            |

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|-----------|-----------|-------------|---------------|-----------------|-----------------|--------------|-------------------|-------------------|----------------|
|           |           |             |               |                 |                 |              |                   | <b>(B+C+D+E)</b>  | <b>(A-F)</b>   |
|           |           |             |               |                 |                 |              |                   |                   |                |
|           |           |             | <b>FY 97</b>  |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |           |             | <b>Approp</b> |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b> | <b>Proj</b> | <b>Value</b>  | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 7         | 23744     | 179         | 4700          | -94             | -4              |              |                   | -98               | 4602           |
|           |           |             | 22864         | -457            | -21             | 0            | 0                 | -478              | 22386          |
| 7         | 23752     | 106         | 3947          | -79             | -4              |              | -30               | -113              | 3834           |
|           |           |             | 3947          | -79             | -4              | 0            | -30               | -113              | 3834           |
| 7         | 23758     | 374         | 90180         | -1803           | -85             | -112         | -55               | -2055             | 88125          |
| 7         | 23758     | 376         | 50000         | -1000           | -47             |              |                   | -1047             | 48953          |
|           |           |             | 140180        | -2803           | -132            | -112         | -55               | -3102             | 137078         |
| 7         | 23801     | 036         | 47291         | -946            | -44             |              | -21               | -1011             | 46280          |
| 7         | 23801     | 303         | 18668         | -373            | -18             |              |                   | -391              | 18277          |
|           |           |             | 65959         | -1319           | -62             | 0            | -21               | -1402             | 64557          |
| 7         | 23802     | 2MT         | 390           | -8              | 0               |              | -4                | -12               | 378            |
| 7         | 23802     | 304         | 4469          | -89             | -4              |              |                   | -93               | 4376           |
| 7         | 23802     | 045         | 3900          | -78             | -4              |              |                   | -82               | 3818           |
| 7         | 23802     | 336         | 1340          | -27             | -1              |              | -10               | -38               | 1302           |
|           |           |             | 10099         | -202            | -9              | 0            | -14               | -225              | 9874           |
| 7         | 23806     | C19         | 3179          | -64             | -3              |              |                   | -67               | 3112           |
|           |           |             | 3179          | -64             | -3              | 0            | 0                 | -67               | 3112           |
| 7         | 23808     | E11         | 6933          | -139            | -7              |              | -21               | -167              | 6766           |
|           |           |             | 6933          | -139            | -7              | 0            | -21               | -167              | 6766           |
| 7         | 28010     | 107         | 18693         | -374            | -18             | -55          | -17               | -464              | 18229          |
|           |           |             | 18693         | -374            | -18             | -55          | -17               | -464              | 18229          |
| 7         | 28053     | 635         | 2124          | -42             | -2              |              | -3                | -47               | 2077           |
|           |           |             | 2124          | -42             | -2              | 0            | -3                | -47               | 2077           |

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|           |                   |             |                |                 |                 |              |                   | (B+C+D+E)         | (A-F)          |
|           |                   |             |                |                 |                 |              |                   |                   |                |
|           |                   |             | <b>FY 97</b>   |                 |                 |              | <b>Sec 8037</b>   | <b>Tot Adj to</b> | <b>FY 97</b>   |
|           |                   |             | <b>Approp</b>  |                 |                 |              | <b>Consulting</b> | <b>Approp</b>     | <b>Column</b>  |
| <b>BA</b> | <b>PE</b>         | <b>Proj</b> | <b>Value</b>   | <b>Sec 8136</b> | <b>Sec 8138</b> | <b>FFRDC</b> | <b>Services</b>   | <b>Value</b>      | <b>on RDDS</b> |
| 7         | 31359             | 381         | 9042           | -181            | -8              |              |                   | -189              | 8853           |
| 7         | 31359             | 382         | 394            | -8              | 0               |              |                   | -8                | 386            |
| 7         | 31359             | H87         | 1749           | -35             | -2              |              |                   | -37               | 1712           |
|           |                   |             | 11185          | -224            | -10             | 0            | 0                 | -234              | 10951          |
| 7         | 33140             | 491         | 2574           | -51             | -2              | -6           |                   | -59               | 2515           |
| 7         | 33140             | 501         | 587            | -12             | -1              |              |                   | -13               | 574            |
|           |                   |             | 3161           | -63             | -3              | -6           | 0                 | -72               | 3089           |
| 7         | 33142             | 253         | 17063          | -341            | -16             | -451         |                   | -808              | 16255          |
| 7         | 33142             | 2PT         | 142            | -3              | 0               |              | -2                | -5                | 137            |
| 7         | 33142             | 384         | 17217          | -344            | -16             | -477         | -222              | -1059             | 16158          |
| 7         | 33142             | 386         | 1029           | -21             | -1              |              |                   | -22               | 1007           |
| 7         | 33142             | 455         | 878            | -18             | -1              |              |                   | -19               | 859            |
| 7         | 33142             | 456         | 4348           | -87             | -4              |              | -18               | -109              | 4239           |
|           |                   |             | 40677          | -814            | -38             | -928         | -242              | -2022             | 38655          |
| 7         | 33150             | C86         | 19804          | -396            | -19             |              |                   | -415              | 19389          |
|           |                   |             | 19804          | -396            | -19             | 0            | 0                 | -415              | 19389          |
| 7         | 35128             | H12         | 487            | -10             | 0               |              |                   | -10               | 477            |
|           |                   |             | 487            | -10             | 0               | 0            | 0                 | -10               | 477            |
| 7         | 78045             | E25         | 48842          | -977            | -46             |              |                   | -1023             | 47819          |
|           |                   |             | 48842          | -977            | -46             | 0            | 0                 | -1023             | 47819          |
|           |                   |             |                |                 |                 |              |                   |                   |                |
|           | <b>TOTAL BA 7</b> |             | <b>769220</b>  | <b>-15385</b>   | <b>-722</b>     | <b>-1634</b> | <b>-718</b>       | <b>-18459</b>     | <b>750761</b>  |
|           |                   |             | <b>5062763</b> | <b>-101257</b>  | <b>-4757</b>    | <b>-3718</b> | <b>-2403</b>      | <b>-112135</b>    | <b>4930628</b> |
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|-----------|-----------|-------------|--------------|-----------------|-----------------|--------------|-----------------|--------------|----------------|
|           |           |             |              |                 |                 |              |                 | (B+C+D+E)    | (A-F)          |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             | FY 97        |                 |                 |              | Sec 8037        | Tot Adj to   | FY 97          |
|           |           |             | Approp       |                 |                 |              | Consulting      | Approp       | Column         |
| <u>BA</u> | <u>PE</u> | <u>Proj</u> | <u>Value</u> | <u>Sec 8136</u> | <u>Sec 8138</u> | <u>FFRDC</u> | <u>Services</u> | <u>Value</u> | <u>on RDDS</u> |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             |              |                 |                 |              |                 |              |                |
|           |           |             |              |                 |                 |              |                 |              |                |
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|  |                   |                     |                     |  |                     |                                  |                     |                              |                     |            |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                                  |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> |                     |                                  |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate              | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
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| A91E In-House Lab Independent Research - Army Res Inst of Behavioral and Social Sciences   | 122               | 127                 | 0                   | 0  | 0                   | 0                                | 0                   | 0                            | 0                   | 249        |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> In-House Laboratory Independent Research (ILIR) provides a source of competitive funds to technical directors to stimulate high quality, innovative research with significant opportunity for payoff in Army warfighting capability. The ILIR program serves as a catalyst for major technology breakthroughs by giving laboratory directors flexibility in implementing novel research ideas and nurturing senior researchers as well as the most promising, developing scientists. The ILIR funding allocation is based on the quality of past performance. Each year, ILIR project reports are submitted from competing Army research organizations to the Office of the Assistant Secretary of Army (Research, Development, and Acquisition). These ILIR reports are subjected to a strenuous technical peer review by a review committee composed of leading scientists and engineers from the National Academy of Sciences, the Army Science Board, and Army Secretariat. ILIR funding allocation for the subsequent year is based on the score assessed by the ILIR review committee. Successful ILIR projects are typically transitioned to start-up projects under 6.1 or 6.2 mission funding within the organization. For example, ILIR research at the Missile Command Research, Development, and Engineering Center (MRDEC) led to the development of a hydrogen/hydrocarbon gas generator for air-breathing propulsion systems. This effort was integrated into the MRDEC 6.2 core propulsion program. Armament Research, Development and Engineering Center (ARDEC) ILIR research investigated dynamic effects on gun tubes and determined methods for controlled tank cannon gun tube vibrations. This effort transitioned to a 6.2 Smart Barrel Actuator program for tank main guns. ILIR research on a low heat rejection engine at the Tank-Automotive Research, Development and Engineering Center (TARDEC) played a major role in engine improvements that were implemented in both M109 Howitzer and Paladin upgrades, approximately 700 total Army vehicles. Other potential spin-offs from this TARDEC ILIR program to tactical trucks and tracked combat vehicles have been considered. Since its establishment by DoD Directive number 3201.4, dated October 8, 1993, the Army's ILIR program has supported and will continue to promote the 1987 Defense Science Board Study</p> |                   |                     |                     |  |                     |                                  |                     |                              |                     |            |
| <i>Page 1 of 9 Pages</i>   |                   |                     |                     |  |                     | <b>Exhibit R-2 (PE 0601101A)</b> |                     |                              |                     |            |



DATE  
**February 1997**

BUDGET ACTIVITY  
**1 - Basic Research**

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

on Technology Base Management's recommendation to attract and retain top light 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.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601101A In-House Laboratory Independent Research</b> |                     |                           |                     |                              | PROJECT<br><b>A91A</b> |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| A91A In-House Laboratory Independent Research -<br>Army Materiel Command   | 9081              | 9686                | 10354               | 10877   | 11440               | 12071                     | 12330               | 12617                        | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> This project provides funding for ILIR research which is allocated among the seven Research, Development and Engineering Centers (RDECs) in the Army Materiel Command (AMC).</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 9081 -Missile RDEC -Improved fast learning neural networks for system control; continued development of photonic band edge technology; developed methodology for characterization of gel propellants; developed algorithms for prediction of helicopter signatures and missile detection.</li> <li>-Armaments RDEC -Evaluated unique phenomena in energetic materials, barrel coatings to reduce barrel wear, dynamic modeling for weapons design and materials for passive shielding from low frequency magnetic fields; continued research in weaponry-unique robotics, voice control and software architecture; supported research in superconductivity and hypervelocity physics.</li> <li>-Tank-Automotive RDEC -Developed nonlinear models of compliant structures, heat transfer mechanisms for cold start engine phenomena, and non-invasive thermal imaging of engine combustion phenomena.</li> <li>-Natick RDEC -Applied fractal analyses to biodegradable materials; examined selected metallic macrocycles for non-linear optical and excited state properties.</li> <li>-Edgewood RDEC -Linked virus simulants with detector molecules (fluorochromes, etc.) and began screening for reactivity; defined most promising theory for correlation of adsorption equilibria with adsorbent properties; used molecular modeling to determine the optimum substrate configuration of dipeptides for improving the performance of nerve agent degrading enzymes; prepared bidentate sulfur containing ligands for ruthenium as candidate dopants for a surface to be used for a light-induced catalytic agent destruction.</li> <li>-Aviation RDEC -Tested and measured aircraft in-flight characteristics; transitioned neural network based helicopter simulator software to support the Free Flight Rotorcraft Research Project and the Autonomous Scout Rotorcraft Testbed technology demonstration program.</li> <li>-Communications-Electronics RDEC -Transitioned antenna programs to core tech base; developed models to enhance imaging sensors capabilities; developed more efficient algorithms for Intelligence and Electronic Warfare data fusion; upgraded sensor simulation/performance models.</li> </ul> <p>Total 9081</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9547 - Missile RDEC -Conduct research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities.</li> </ul> |                   |                     |                     |   |                     |                           |                     |                              |                        |            |
| Project A91A   |                   |                     | Page 2 of 9 Pages   |   |                     | Exhibit R-2 (PE 0601101A) |                     |                              |                        |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> | <b>PROJECT</b><br><b>A91A</b> |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Armaments RDEC -Evaluate unique phenomena in weapons and munitions related research, focusing on gun/cannon barrel erosion prevention and energetic materials for various weaponry applications.</li> <li>- 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.</li> <li>- Natick RDEC -Identify innovative technologies in the areas of molecular biology, biopolymers and modeling of personnel equipment characteristics.</li> <li>- Edgewood RDEC -Investigate innovative approaches to pathogen detection including development of DNA super libraries and genome sequencing of pathogens; begin development of respirator encumbrance model for the individual soldier.</li> <li>- Aviation RDEC -Demonstrate a new rapid, non-intrusive velocity measurement technique, Doppler Global Velocimetry, for measuring rotorcraft 3D flow fields.</li> <li>- Communications-Electronics RDEC -Develop antenna and sensor technologies and computer models; improve intelligence data fusion techniques; upgrade sensor simulation/performance models.</li> </ul> <p>• 139 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</p> <p>Total 9686</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 10354 - Missile RDEC - Conduct research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities; demonstrate and transition components and concepts.</li> <li>- Armaments RDEC -Investigate processes for real-time material characterization, advanced energetic materials development, and controlled biodegradation of battlefield explosives.</li> <li>- Tank-Automotive RDEC -Use fractals to analyze visual signatures; optimize laser-induced breakdown directed energy protection devices; implement singular perturbed non-linear track model on a supercomputer; investigate non-linear controllers for active suspension systems.</li> <li>- Natick RDEC -Use innovative modeling tools for characterizing materials/fabrics/food constituents for application to military clothing and ration systems with the goal of improving soldier protection and performance.</li> <li>- Edgewood RDEC -Complete investigation of innovative approaches to biodetection via DNA super libraries and genome sequencing of biological agents; transition investigation to core program. Complete development of respirator encumbrance model and transition to exploratory development.</li> <li>- Aviation RDEC -Develop and demonstrate techniques for active control of rotor blades for high-lift and/or for reduced vibration.</li> <li>- Communications-Electronics RDEC -Transition intelligence data fusion techniques to core technology base; improve battlefield visualization software tools; develop antenna and sensor technologies and virtual prototyping models; upgrade sensor simulation performance models; explore advanced battery technology.</li> </ul> |  |                               |
| Project A91A   | Page 3 of 9 Pages  | Exhibit R-2 (PE 0601101A)     |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> | <b>PROJECT</b><br><b>A91A</b> |                |                |
| Total            10354   |  |                               |                |                |
| <b>FY 1999 Planned Program:</b> <ul style="list-style-type: none"> <li>•            10877 - Missile RDEC - Conduct research on high quality projects leading to new and improved missile sensors, propulsion, guidance and control, and structural capabilities; demonstrate and transition components and concepts.</li> <li>             - Armaments RDEC -Evaluate micro-electro mechanical systems (MEMS) technology for low-cost projectile guidance and control; continue investigations into real-time material characterizations and advanced energetic materials.</li> <li>             - Tank-Automotive RDEC -Correlate ignition delays with combustion temperature and pressure profiles; automate multibody dynamic systems modeling using algebraic constraints; calculate 3-D stress distributions in thick composite materials.</li> <li>             - Natick RDEC -Validate models of materials/fabric/food constituents against known parameters, transfer results to core basic research and applied research programs in ration and clothing research.</li> <li>             - Edgewood RDEC -Initiate project to prove concept for a specific virus detector. Begin construction of data reduction/analysis algorithms needed for the development of a satellite/high altitude chemical imaging sensor.</li> <li>             - Aviation RDEC -Investigate application of "smart materials" and/or micro-electro mechanical systems (MEMS) for alleviation of dynamic stall to improve rotor aerodynamics.</li> <li>             - Communications-Electronics RDEC -Upgrade battlefield visualization tools; transition antenna technologies; improve power sources technology, advance sensor technology base.</li> </ul> |  |                               |                |                |
| Total            10877   |  |                               |                |                |
| <b><u>B. Project Change Summary</u></b>  |  |                               |                |                |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 9255   | 9893                          | 10803          | 11727          |
| Appropriated Value   | 9513   | 9686                          |                |                |
| Adjustments to Appropriated Value  | -432   |                               |                |                |
| FY 1998 Pres Bud Request   | 9081   | 9686                          | 10354          | 10877          |

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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|-------------------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>A91C</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| A91C In-House Laboratory Independent Research -<br>Medical Research and Materiel Command  | 3721              | 3828                | 3968                | 4126   | 4321                | 4488                | 4581                      | 4687                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> Represents funds to conduct ILIR research allocated among the six laboratories of the Medical Research and Materiel Command, including the Aeromedical Research Laboratory, the Institute of Surgical Research, the Institute of Environmental Medicine, the Medical Institute of Chemical Defense, the Medical Institute of Infectious Diseases and Walter Reed Army Institute of Research.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3721 - Conducted research in medical countermeasures against naturally occurring infectious diseases which may have significant impacts on military operations to protect the force from infection and sustain operations.</li> <li>- Conducted research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness.</li> <li>- Conducted 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.</li> </ul> <p>Total 3721</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3735 - 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.</li> <li>- Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness.</li> <li>- 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.</li> <li>• 93 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3828</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3968 - 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.</li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project A91C  |                   |                     | Page 5 of 9 Pages   |  |                     |                     | Exhibit R-2 (PE 0601101A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|---------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|-------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> | <b>PROJECT</b><br><b>A91C</b> |                |                |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness.</li> <li>- 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.</li> </ul> <p>Total            3968</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            4126 - 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.</li> <li>- Continue research in medical defense against environmental extremes and operational hazards to health focusing on physiological and psychological factors limiting soldier effectiveness.</li> <li>- 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.</li> </ul> <p>Total            4126</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY1997 President’s Budget</td> <td style="text-align: center;">3817</td> <td style="text-align: center;">3910</td> <td style="text-align: center;">4269</td> <td style="text-align: center;">4369</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3924</td> <td style="text-align: center;">3828</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-203</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">3721</td> <td style="text-align: center;">3828</td> <td style="text-align: center;">3968</td> <td style="text-align: center;">4126</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY1997 President’s Budget | 3817 | 3910 | 4269 | 4369 | Appropriated Value | 3924 | 3828 |  |  | Adjustments to Appropriated Value | -203 |  |  |  | FY1998 Pres Bud Request | 3721 | 3828 | 3968 | 4126 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| FY1997 President’s Budget  | 3817   | 3910                          | 4269           | 4369           |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| Appropriated Value   | 3924   | 3828                          |                |                |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| Adjustments to Appropriated Value  | -203   |                               |                |                |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| FY1998 Pres Bud Request  | 3721   | 3828                          | 3968           | 4126           |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| Project A91C   | Page 6 of 9 Pages  | Exhibit R-2 (PE 0601101A)     |                |                |                |                |                |                           |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
|--|-------------------|---------------------|--------------------------|--|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                          | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> |                     |                     |                           | <b>PROJECT</b><br><b>A91D</b> |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| A91D In-House Laboratory Independent Research - Corps of Engineers   | 733               | 752                 | 791                      | 825  | 862                 | 893                 | 910                       | 927                           | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> Represents funds to conduct ILIR research allocated among the four laboratories within the Army Corps of Engineers, including the Topographic Engineering Center, the Waterways Experimental Station, the Construction Engineering Research Laboratories and the Cold Regions Research and Engineering Laboratory.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 733 - Conducted studies in dynamic terrain representation for simulation and computerized terrain data analysis techniques at the Topographic Engineering Center.</li> <li>- Developed chemical oxidation techniques for explosive contamination on oversized solids; enhanced technology for identification and quantification of lighter petroleum fraction compounds at the Waterways Experimental Station.</li> <li>- Performed mathematical modeling, lab testing and computer simulation of electromagnetic phenomena in inverter-fed AC rotating machines at the Construction Engineering Research Laboratories.</li> <li>- Examined the fundamental diffusion processes of organic compounds in snow and explore the relationship between snow metamorphosis and avalanche release mechanisms at the Cold Regions Research and Engineering Laboratory.</li> </ul> <p>Total 733</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 734 - Continue research in the terrain representation process and terrain data generation by sponsoring related topics in these areas at the Topographic Engineering Center.</li> <li>- Determine in vitro molecular and cellular toxicity of TNT, RDX, and HMX explosives to establish biomarkers of exposure at the Waterways Experimental Station.</li> <li>- Develop simplified, parameter-insensitive, sensorless machine control techniques at the Construction Engineering Research Laboratories.</li> <li>- Explore physics based correlations between mechanical and electrical properties of sea ice as a basis for translation of satellite sensor data to physical behavior and examine means to characterize the diffusion of various chemical species through frozen soils and permafrost at the Cold Region Research and Engineering Laboratory.</li> <li>• 18 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 752</p> |                   |                     |                          |  |                     |                     |                           |                               |                     |            |
| Project A91D   |                   |                     | <i>Page 7 of 9 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0601101A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|---------------------------|-----|-----|-----|-----|--------------------|-----|-----|--|--|-----------------------------------|-----|--|--|--|-------------------------|-----|-----|-----|-----|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> | <b>PROJECT</b><br><b>A91D</b> |                |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 791 - Devise automated classification and feature extraction algorithms for Georegistered Interferometric Synthetic Aperture Radar and Hyperspectral Imagery.             <ul style="list-style-type: none"> <li>- Develop a simulation model and laboratory performance test for evaluation of fundamental machines.</li> <li>- Develop interference pattern approach for subsurface object detection in snow/frozen ground.</li> <li>- Determine hydrodynamic interaction of sediment mitigation and in-situ object transport in harbors, rivers and areas in proximity to Logistics Over The Shore operations.</li> </ul> </li> </ul> <p>Total 791</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 825 - Exploit image statistics from multi-scale transforms for extraction of topographic information from imagery.             <ul style="list-style-type: none"> <li>- Demonstrate the feasibility of shaft sensorless control systems capable of determining the vibration characteristics of rotating machine technology.</li> <li>- Develop hyperspectral approach for snow cover property assessment.</li> <li>- Develop transport mechanisms (including chemical interactions) of contaminants through porous media at micropore scale.</li> </ul> </li> </ul> <p>Total 825</p> <p><b><u>B. Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY1997 President's Budget</td> <td style="text-align: center;">753</td> <td style="text-align: center;">768</td> <td style="text-align: center;">840</td> <td style="text-align: center;">860</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">773</td> <td style="text-align: center;">752</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-40</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">733</td> <td style="text-align: center;">752</td> <td style="text-align: center;">791</td> <td style="text-align: center;">825</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY1997 President's Budget | 753 | 768 | 840 | 860 | Appropriated Value | 773 | 752 |  |  | Adjustments to Appropriated Value | -40 |  |  |  | FY1998 Pres Bud Request | 733 | 752 | 791 | 825 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |
| FY1997 President's Budget  | 753  | 768                           | 840            | 860            |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |
| Appropriated Value   | 773  | 752                           |                |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |
| Adjustments to Appropriated Value  | -40  |                               |                |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |
| FY1998 Pres Bud Request  | 733  | 752                           | 791            | 825            |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |
| Project A91D   | Page 8 of 9 Pages  | Exhibit R-2 (PE 0601101A)     |                |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                         |     |     |     |     |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |  |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
|--|-------------------|---------------------|--------------------------|--|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|---------------------------|-----|-----|-----|-----|--------------------|-----|-----|--|--|-----------------------------------|----|--|--|--|-------------------------|-----|-----|---|---|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                          | <b>PE NUMBER AND TITLE</b><br><b>0601101A In-House Laboratory Independent Research</b> |                     |                           |                     | <b>PROJECT</b><br><b>A91E</b> |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| A91E In-House Lab Independent Research - Army Res<br>Inst of Behavioral and Social Sciences  | 122               | 127                 | 0                        | 0  | 0                   | 0                         | 0                   | 0                             | 0                   | 249        |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> Represents funds allocated to the Army Research Institute for Behavioral and Social Sciences to conduct ILIR research.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 122 - Investigated the role of distance estimation and configuration learning in virtual environments.</li> </ul> <p>Total 122</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 124 - Conduct research on the transfer of training from virtual to real environments.</li> <li>• 3 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 127</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY1997 President's Budget</td> <td style="text-align: center;">125</td> <td style="text-align: center;">130</td> <td style="text-align: center;">143</td> <td style="text-align: center;">147</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">130</td> <td style="text-align: center;">127</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-8</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">122</td> <td style="text-align: center;">127</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Due to program restructuring, the ILIR program is no longer funded for ARI beyond FY1997.</p> |                   |                     |                          |  |                     |                           |                     |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY1997 President's Budget | 125 | 130 | 143 | 147 | Appropriated Value | 130 | 127 |  |  | Adjustments to Appropriated Value | -8 |  |  |  | FY1998 Pres Bud Request | 122 | 127 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>           | <u>FY 1999</u>   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| FY1997 President's Budget  | 125               | 130                 | 143                      | 147  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| Appropriated Value   | 130               | 127                 |                          |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| Adjustments to Appropriated Value  | -8                |                     |                          |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| FY1998 Pres Bud Request  | 122               | 127                 | 0                        | 0  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |
| Project A91E   |                   |                     | <i>Page 9 of 9 Pages</i> |  |                     | Exhibit R-2 (PE 0601101A) |                     |                               |                     |            |  |                |                |                |                |                           |     |     |     |     |                    |     |     |  |  |                                   |    |  |  |  |                         |     |     |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |                   |                     |                     |  |                     |                     |                     |                     | DATE<br><b>February 1997</b> |            |
|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------|---------------------|------------------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>                   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                     |                     |                              |            |
| <i>COST (In Thousands)</i>                                     | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete          | Total Cost |
| Total Program Element (PE) Cost                                | 121822            | 119739              | 138165              | 141555   | 142369              | 144927              | 146800              | 150031              | Continuing                   | Continuing |
| AF20 Advanced Propulsion Research                              | 2118              | 2284                | 2414                | 2512   | 2630                | 2733                | 2790                | 2871                | Continuing                   | Continuing |
| AF22 Research in Vehicular Mobility                            | 473               | 438                 | 542                 | 567  | 591                 | 610                 | 621                 | 632                 | Continuing                   | Continuing |
| AH42 Materials and Mechanics                                   | 1548              | 1738                | 1921                | 2000   | 2094                | 2176                | 2222                | 2269                | Continuing                   | Continuing |
| AH43 Research in Ballistics                                    | 4853              | 5466                | 5827                | 6059   | 6345                | 6594                | 6735                | 6952                | Continuing                   | Continuing |
| AH44 Advanced Sensors Research                                 | 1685              | 3284                | 4902                | 5047   | 3750                | 3896                | 3978                | 4105                | Continuing                   | Continuing |
| AH45 Air Mobility  | 1829              | 1809                | 2191                | 2280   | 2385                | 2477                | 2528                | 2584                | Continuing                   | Continuing |
| AH47 Applied Physics Research                                  | 2613              | 2751                | 3083                | 3207   | 3359                | 3489                | 3564                | 3688                | Continuing                   | Continuing |
| AH48 Battlespace Information & Communications Res              | 0                 | 6729                | 6199                | 7925   | 6988                | 6417                | 8617                | 8110                | Continuing                   | Continuing |
| AH52 Equipment for the Soldier                                 | 941               | 831                 | 1014                | 1056   | 1105                | 1145                | 1167                | 1192                | Continuing                   | Continuing |
| BH57 Scientific Problems with Military Applications            | 53307             | 46812               | 58174               | 56475  | 56343               | 57313               | 56697               | 58230               | Continuing                   | Continuing |
| AH66 Advanced Structures Research                              | 1257              | 1287                | 1405                | 1465   | 1532                | 1590                | 1622                | 1669                | Continuing                   | Continuing |
| BH67 Environmental Research - Army Material Cmd                | 3811              | 4798                | 5709                | 4917   | 5575                | 5598                | 4603                | 4795                | Continuing                   | Continuing |
| AH68 Processes in Pollution Abatement Technology               | 419               | 343                 | 427                 | 447  | 465                 | 283                 | 291                 | 300                 | Continuing                   | Continuing |
| BS04 Military Pollutants and Health Hazards                    | 649               | 585                 | 718                 | 750  | 782                 | 516                 | 531                 | 546                 | Continuing                   | Continuing |
| BS13 Science Base/Medical Research Infectious Disease          | 8964              | 8253                | 10209               | 11357  | 11763               | 12169               | 12883               | 13145               | Continuing                   | Continuing |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |                   |                     |                     |   |                     |                     |                     |                     | DATE<br><b>February 1997</b> |            |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|---------------------|------------------------------|------------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>            |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                     |                     |                              |            |
| <i>COST (In Thousands)</i>                                     | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete          | Total Cost |
| BS14 Science Base/Combat Casualty Care Research                | 4071              | 3749                | 4523                | 4702  | 4925                | 5118                | 5224                | 5346                | Continuing                   | Continuing |
| BS15 Science Base/Army Operational Medicine Research           | 6654              | 5543                | 6094                | 6863  | 7139                | 7418                | 7574                | 7752                | Continuing                   | Continuing |
| BS16 Science Base/Combat Dentistry Research                    | 464               | 459                 | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 923        |
| BS17 Molecular Biology/Military HIV Research                   | 877               | 783                 | 499                 | 482   | 552                 | 592                 | 612                 | 635                 | Continuing                   | Continuing |
| BS18 Marine Derived Biocatalysts                               | 0                 | 636                 | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 636        |
| AT22 Soil and Rock Mechanics                                   | 1897              | 1730                | 2095                | 2180  | 2281                | 2369                | 2416                | 2470                | Continuing                   | Continuing |
| AT23 Basic Research/Military Construction                      | 1788              | 1500                | 1818                | 1892  | 1979                | 2054                | 2095                | 2143                | Continuing                   | Continuing |
| AT24 Snow, Ice and frozen Soil                                 | 1210              | 1104                | 1343                | 1399  | 1462                | 1517                | 1547                | 1581                | Continuing                   | Continuing |
| BT25 Environmental Research - Corps of Engineers               | 4725              | 3070                | 3608                | 4001  | 3749                | 3757                | 3091                | 3214                | Continuing                   | Continuing |
| A305 Automatic Target Recognition Research                     | 1034              | 1132                | 1186                | 1237  | 1292                | 1340                | 1368                | 1409                | Continuing                   | Continuing |
| A31B Infrared Optics Research                                  | 2075              | 2233                | 2330                | 2425  | 2538                | 2637                | 2693                | 2771                | Continuing                   | Continuing |
| B52C Mapping and Remote Sensing                                | 2408              | 2196                | 2655                | 2763  | 2892                | 3003                | 3066                | 3137                | Continuing                   | Continuing |
| B53A Battlefield Environment and Signature                     | 5407              | 3530                | 3672                | 3822  | 4003                | 4160                | 4249                | 4378                | Continuing                   | Continuing |
| B74A Human Engineering   | 2110              | 2255                | 2620                | 2728  | 2856                | 2966                | 3029                | 3121                | Continuing                   | Continuing |
| B74F Personnel Performance and Training                        | 2635              | 2411                | 987                 | 997   | 994                 | 990                 | 987                 | 986                 | Continuing                   | Continuing |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b> |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                              |
| <p><b><u>Mission Description and Budget Item Justification</u></b>: 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 applied research (6.2) and, eventually, advanced technology development (6.3) programs.</p> <p>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 0602618A (Ballistics 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 (Medical Technology), PE 0603105A (Medical Human Immunodeficiency Virus (HIV) Research), PE 0603002A (Medical Advanced Technology), PE 0603807A (Medical Systems-Advanced Development), PE 0604807A (Medical Materiel/Medical Defense Equipment-Engineering Development), PE 0605801A (Program wide Activities, Project MMO2), PE 0605898A (Management Headquarters R &amp; D, Project MMO3), and PE 0601103D (University Research Initiatives); the Navy, Air Force, and other Department of Defense agencies; National Aeronautics and Space Administration; National Science Foundation; Department of the Interior; Department of Energy; National Bureau of Standards; other government agencies; and government agencies of Allied nations sponsor related research in areas of this program.</p> |   |                              |
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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>AF20</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AF20 Advanced Propulsion Research  | 2118              | 2284                | 2414                | 2512   | 2630                | 2733                | 2790                      | 2871                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 rotorcraft and tracked and wheeled vehicles. Analysis, code development, experiments and evaluations are conducted to improve engine and drive train components and investigate advanced materials. Component level investigations include compressors, combustors, turbines, injectors, pistons, cylinder liners, piston rings, gears, seals, bearings, shafts, and controls. The goal of the activity is increased performance of small airbreathing engines and power trains, to support improvements in system mobility, reliability and survivability.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2118 - Completed investigation of the effects of shrouded stator seal cavities on compressor and stator performance for several stator cavity leakage rates.</li> <li>- Completed "reduced chemistry" model for advanced combustor code.</li> <li>- Completed model of crack propagation in thin rim gears. Completed low noise gearbox validation experiments.</li> <li>- Completed analysis of a powder lubricated composite slider bearing using the continuum model approach.</li> <li>- Investigated high temperature fatigue life model, and completed ceramic matrix composite oxidation protection studies. Investigated characterization of high-temperature polymer mechanical properties retention.</li> <li>- Included deformation effects in journal bearing code.</li> </ul> <p>Total 2118</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2284 - Complete diffuser flow field tests for large, low-speed centrifugal compressor.</li> <li>- Complete carbon deposits/radiation modeling for advanced combustor code; release code (ALLSPD-3D, version 2.0) to industry.</li> <li>- Develop analytical tools for low noise face gears. Develop concepts for non-ferrous gears. Validate performance of thin-rimmed, high-speed gears.</li> <li>- Complete solid lubrication model development.</li> <li>- Characterize advanced ceramic matrix composite oxidation-resistant coatings.</li> <li>- Test experimental oxidation-resistant coatings for high-temperature polymers.</li> <li>- Complete linear stability analysis for finite (with end effects) journal bearing.</li> </ul> <p>Total 2284</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project AF20   |                   |                     | Page 4 of 66 Pages  |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AF20</b> |                |                |
| <b>FY 1998 Planned Program:</b>  |   |                               |                |                |
| <ul style="list-style-type: none"> <li>• 2414 - Complete investigation of impeller/diffuser interaction for large, low-speed centrifugal compressor.</li> <li style="padding-left: 20px;">- Complete version 1.0 (unstructured grid version) of National Combustor Code and release to U.S. Industry.</li> <li style="padding-left: 20px;">- Obtain fundamental heat transfer data for developing/validating "wall function" models for 3D Navier Stokes internal/external cooling flow calculations.</li> <li style="padding-left: 20px;">- Complete 3D crack prediction code for spiral bevel gears.</li> <li style="padding-left: 20px;">- Complete characterization of oxidation resistant coatings for advanced ceramic matrix composites.</li> <li style="padding-left: 20px;">- Develop high temperature, stable graphite/polyimide sheet molding compound (SMC) for engine component applications.</li> <li style="padding-left: 20px;">- Complete characterization of advanced ceramic coating materials for low heat rejection diesel engine application.</li> </ul> <p>Total 2414</p>                                       |   |                               |                |                |
| <b>FY 1999 Planned Program:</b>  |   |                               |                |                |
| <ul style="list-style-type: none"> <li>• 2512 - Characterize inlet distortion effects on impeller performance for large, low-speed centrifugal compressor.</li> <li style="padding-left: 20px;">- Demonstrate quick execution (overnight turnaround) for version 2.0 of the National Combustor Code.</li> <li style="padding-left: 20px;">- Characterize the coupling between internal convection and external film cooling for turbines.</li> <li style="padding-left: 20px;">- Complete high speed gearing thermal behavior code.</li> <li style="padding-left: 20px;">- Conduct preliminary screening of candidate materials for very high temp. (&gt;3000 degrees F) applications.</li> <li style="padding-left: 20px;">- Develop short term (&lt;1 week) thermal characterization methodology for correlating actual long term (life time) thermo-oxidative stability of polymer composites.</li> <li style="padding-left: 20px;">- Define complete advanced coating system for low heat rejection diesel engine application (multiple layer processing, structural analyses, and characterization).</li> </ul> <p>Total 2512</p> |   |                               |                |                |
| <b>B. Project Change Summary</b>   |   |                               |                |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 2176  | 2365                          | 2408           | 2448           |
| Appropriated Value   | 2236  | 2284                          |                |                |
| Adjustments to Appropriated Value  | -118  |                               |                |                |
| FY 1998 Pres Bud Request   | 2118  | 2284                          | 2414           | 2512           |
| Project AF20   |   |                               |                |                |
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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                           |                     | <b>PROJECT</b><br><b>AF22</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AF22 Research in Vehicular Mobility   | 473               | 438                 | 542                 | 567   | 591                 | 610                       | 621                 | 632                           | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> This project conducts research in support of advanced military engine technology with emphasis on advanced propulsion, sophisticated vehicle dynamics and simulation, and advanced track and suspension concepts. Advanced propulsion research will dramatically improve power density, performance and thermal efficiency for advanced adiabatic diesel engines, transient heat transfer, high temperature materials and thermodynamics. This project also supports state-of-the-art simulation technologies to achieve a more fundamental understanding of advanced high-output military engines. The subject research is directed at unique, state-of-the-art phenomena in the specific areas of: 1) non-linear ground vehicle control algorithms, using off-road terrain characteristics; and 2) instantaneous diesel engine low friction/cold start optimizations, using advanced analytical and experimental procedures. The subject efforts offer an opportunity to produce quantum Army ground vehicle performance enhancements through the use of optimized parameterization procedures.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 473 - Conducted research to optimize symbolic numerical algorithms which permit accurate, real-time, and cost effective dynamic vehicle simulation.             <ul style="list-style-type: none"> <li>-Refined vehicle/human interface theory to allow accurate predictability of phenomena.</li> <li>-Developed vehicle dynamic theory permitting real-time simulation of active control characteristics.</li> <li>-Developed fundamental simulative models for advanced ground vehicle powertrain components.</li> </ul> </li> </ul> <p>Total 473</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 431 -Validate symbolic numerical algorithms within real-time vehicle dynamic scenarios.             <ul style="list-style-type: none"> <li>-Enhance numerical computational efficiencies of simulative models describing vehicle/human interfaces.</li> <li>-Demonstrate control algorithms for autonomous neural networks in support of vehicle accident avoidance.</li> <li>-Optimize and validate fundamental simulative models for unique ground vehicle powertrain component combinations.</li> </ul> </li> <li>• 7 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 438</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 542 - Formulate state-of-the-art non-linear vehicle dynamics insights.             <ul style="list-style-type: none"> <li>- Establish vehicle/human control algorithms for military systems performance enhancements.</li> <li>- Validate fundamental powertrain component models for unique ground vehicles.</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                           |                     |                               |                     |            |
| Project AF22  |                   |                     | Page 6 of 66 Pages  |   |                     | Exhibit R-2 (PE 0601102A) |                     |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AF22</b> |                |                |
| Total            542  |   |                               |                |                |
| <b>FY 1999 Planned Program:</b>   |   |                               |                |                |
| <ul style="list-style-type: none"> <li>•            567 - Validate state-of-the-art vehicle dynamics phenomena.</li> <li style="padding-left: 40px;">- Optimize vehicle/human control models for off-road scenarios.</li> <li style="padding-left: 40px;">- Optimize fundamental powertrain characteristic phenomena using advanced simulation procedures.</li> </ul> |   |                               |                |                |
| Total            567  |   |                               |                |                |
| <b>B. <u>Project Change Summary</u></b>   |   |                               |                |                |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget  | 484   | 521                           | 542            | 567            |
| Appropriated Value  | 498   | 438                           |                |                |
| Adjustments to Appropriated Value   | -25   |                               |                |                |
| FY 1998 Pres Bud Request  | 473   | 438                           | 542            | 567            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                           |   |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                           | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>AH42</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate       | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| AH42 Materials and Mechanics   | 1548              | 1738                | 1921                      | 2000  | 2094                | 2176                | 2222                      | 2269                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> 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 performance and failure mechanisms of materials subjected to high impact and strain rates (armor/armaments); the barrier properties and performance characteristics of materials subjected to chemical, biological and directed energy threats; and the durability, service life and maintenance of candidate materials for soldier systems, personnel support, armor, armaments, aircraft, ground and combat vehicles, and combat support.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1548 -Synthesized and characterized bulk ferroelectric composites for phased array antenna applications.</li> <li>-Determined shock induced damage in armor materials under oblique impact/shock.</li> <li>-Correlated hydrogen bonding energies with microstructural constituents in high strength steels intended for aviation and armor use.</li> <li>-Converted an elastic higher-order thick beam theory developed by NASA into a highly viscous quasi-static higher-order thick beam theory; completed finite element analysis of composite armored vehicle-like thick curved composite laminates to determine strain energy release rates.</li> </ul> <p>Total 1548</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1738 -Establish the science base for creating and producing special function electrical, magnetic, optical, chemical-biological protective, and smart-responsive materials.</li> <li>-Provide an enhanced knowledge base of the relationship between microstructure and mechanisms of flow and failure in materials subjected to high strain rates typical of armor/anti-armor events.</li> <li>-Provide an enhanced knowledge base to relate the structure and properties of metal, ceramic, polymer, composite and hybrid materials surfaces and interphases to improve performance and long-term durability.</li> <li>-Include dynamics in the viscous quasi-static higher-order thick beam theory, and initiate installation of theory in NASA's COMET Finite Element code; conduct parametric studies and tests to understand influence of lay-up and geometry on strength and failure of thick curved composite laminates.</li> </ul> <p>Total 1738</p> |                   |                     |                           |   |                     |                     |                           |                              |                               |            |
| Project AH42   |                   |                     | <i>Page 8 of 66 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |   | DATE<br><b>February 1997</b>  |                           |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>            | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b>   | <b>PROJECT</b><br><b>AH42</b> |                           |                |
| <b>FY 1998 Planned Program:</b>                                |   |                               |                           |                |
| • 800  | -Explore novel processing techniques for low cost production of smart composite materials.<br>-Develop novel high performance whiskerized functional graded aluminum metal matrix composite (MMC) armor material.<br>-Scale-up the metal oxide deposition (MOD) process for large area and thicker films and investigate the application of metal oxide chemical vapor deposition (MOCVD) process for deposition of thin films. |                               |                           |                |
| • 500  | -Design improved primers by generalizing molecular models to predict effects of contaminants and environments on bonding.<br>-Investigate processing behavior and characterize microstructure-properties of novel biomimetic ceramic materials.<br>-Investigate various ion beam hydrogen depth profiling techniques for measuring constituents which affect reliability/ballistic performance for armor alloys.                |                               |                           |                |
| • 445  | -Extend constitutive models to predict impact damage in 3-D polymer matrix composites.<br>-Investigate relationship of fiber-matrix interface strength for selection of composites with reduced momentum transfer.  |                               |                           |                |
| • 176  | -Include thermal effects in the new constitutive models for both elastomers and composites; develop and validate failure criteria for thick curved composite laminates.   |                               |                           |                |
| Total  | 1921  |                               |                           |                |
| <b>FY 1999 Planned Program:</b>                                |   |                               |                           |                |
| • 819  | -Develop constitutive models describing mesoscale, smart sensors/actuators in multi-functional composites.<br>-Investigate fundamentals of processing and microstructure-properties studies of biomimetic materials.<br>-Investigate processing and microstructure-property behavior of novel functional graded aluminum MMC materials.   |                               |                           |                |
| • 500  | -Develop and verify models for diffusion-enhanced bonding of integrated composite systems.<br>-Demonstrate/evaluate high throwing power plasma deposited coatings.  |                               |                           |                |
| • 500  | -Conduct fundamental studies to understand material response under extreme ballistic environment.<br>-Extend constitutive models to predict impact damage in thick-section, integrated composite materials.   |                               |                           |                |
| • 181  | -Investigate computational difficulties associated with simulating manufacturing of composite structures made with elastomers; initiate failure analysis of embedded armor composite hybrid structures.   |                               |                           |                |
| Total  | 2000  |                               |                           |                |
| <b>B. Project Change Summary</b>                               |   |                               |                           |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget                                     | 1553  | 1879                          | 2005                      | 2167           |
| Appropriated Value   | 1597  | 1738                          |                           |                |
| Adjustments to Appropriated Value                              | -49   |                               |                           |                |
| FY 1998 Pres Bud Request                                       | 1548  | 1738                          | 1921                      | 2000           |
| Project AH42   | <i>Page 9 of 66 Pages</i>   |                               | Exhibit R-2 (PE 0601102A) |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>AH43</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AH43 Research in Ballistics  | 4853              | 5466                | 5827                | 6059   | 6345                | 6594                | 6735                      | 6952                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> This project establishes the science base for developing the fundamental understanding of ballistic phenomena unique to Army and DoD weapons systems. A multidisciplinary approach is taken with an emphasis on combustion chemistry, physics and fluid dynamics, physics of explosive materiel, interior ballistic reaction kinetics, and terminal ballistic phenomena. The research accomplished under this project will lead to ballistics technologies that will enhance the lethality and survivability of Army and DoD combat systems.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4853 -Formulated liquid propellant jet breakup and combustion algorithms applicable to the high pressure regime in guns.<br/>-Conducted interior ballistic simulations of a granular solid propellant at high initial loading density and subjected to external (e.g., plasma) energy addition; assessed its combustion stability.<br/>-Extended current models of non-steady rod penetration to include length/diameter (L/D) effects and demonstrated utility by comparing with penetration over a range of L/D values.<br/>-Incorporated infrared tracker technologies in real-time range demonstration of counter-kinetic energy components.<br/>-Investigated collateral effects of electromagnetic (EM) environments from pulsed power sources and electromagnetic (EM) guns and systems on host vehicles, personnel and on other nearby assets.</li> </ul> <p>Total 4853</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5387 -Develop submodels of the surface and subsurface physics and chemistry of nitramine composite propellants which account for oxidizer particle-size dependence on burning rate.<br/>-Develop a finite element model capable of computing the transverse loads and accelerations imparted to sensitive projectile guidance and control components inside a gun tube.<br/>-Develop a simple analytical model for ceramic armor elements, including the dwell phenomenon, using a minimum of model-based parameters.<br/>-Exploit theoretical and experimental capabilities to develop EM armor scaling relationships.</li> <li>• 79 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5466</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project AH43   |                   |                     | Page 10 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AH43</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5827 -Initiate development of 2D and 3D computational tools for understanding the electrodynamics of moving conductors by treating the motion of liquids, plasmas, and material undergoing elastic-plastic deformation in electromagnetic fields.</li> <li>-Apply classical forcefields to predict known physical properties and initial reaction steps for nitramine propellant combustion.</li> <li>-Demonstrate test-bed for constitutive properties of composites in artillery/mortar applications.</li> <li>-Determine how the high shear rate mechanical properties of energetic materials affect their initiation behavior.</li> </ul> <p>Total 5827</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6059 -Conduct high speed, quantitative spectroscopy on munition impact flash and gun muzzle flash to reduce the technical barriers for applying emerging optical sensing technologies to the battlefield.</li> <li>-Explore the ignition and combustion characteristics of typical slurry propellant mixture proposed for high loading-density gun systems.</li> <li>-Develop coupled computational fluid dynamic/rigid body dynamic finite difference methodology to apply to the aerodynamic response of tube launched rockets and smart munitions shapes.</li> <li>-Develop a qualitative picture of ballistic failure processes based on the flow and failure of materials under conditions of ballistic impact.</li> </ul> <p>Total 6059</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4921</td> <td style="text-align: center;">5738</td> <td style="text-align: center;">5860</td> <td style="text-align: center;">6006</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5059</td> <td style="text-align: center;">5466</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-206</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4853</td> <td style="text-align: center;">5466</td> <td style="text-align: center;">5827</td> <td style="text-align: center;">6059</td> </tr> </tbody> </table> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4921 | 5738 | 5860 | 6006 | Appropriated Value | 5059 | 5466 |  |  | Adjustments to Appropriated Value | -206 |  |  |  | FY 1998 Pres Bud Request | 4853 | 5466 | 5827 | 6059 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 4921  | 5738                          | 5860           | 6006           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 5059  | 5466                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -206  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 4853  | 5466                          | 5827           | 6059           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AH43  | Page 11 of 66 Pages   | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b>  |                     |            |  |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                     | <b>PROJECT</b><br><b>AH44</b> |                     |            |  |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |
| AH44 Advanced Sensors Research   | 1685              | 3284                | 4902                | 5047  | 3750                | 3896                | 3978                | 4105                          | Continuing          | Continuing |  |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project exploits new opportunities in the basic sciences underpinning the technology areas of digital and image processing modules and algorithms, optical control of radar sensors, nonlinear optical materials and devices, remote sensing, and intelligent system distributive interactive simulations. Research involves fundamental science and engineering principles that support survivable sensor systems. Monolithic and hybrid optoelectronic structures in gallium arsenide and lithium niobate are investigated as integrated processors for novel signal and radar processing and control. Diffractive and micro-optic elements are developed to enhance performance of imagers and optical processors. For laser protection, nonlinear optical effects are being explored which will allow broad band protection. These nonlinear effects can also be used for optical image processing or holographic displays and storage. For remote sensing applications, research in materials is conducted that will allow direct lasing in the ultraviolet (UV) wavelength region.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1685 -Designed, constructed and characterized optical processors for image and signal processing, incorporating refractive, diffractive and/or integrated optical elements.</li> <li>-Continued research on components for optical control of microwaves by combining integrated optic beam splitter with phase modulators and amplifier structures.</li> <li>-Developed, tested and characterized wideband high-resolution, direction-finding, acoustic algorithms for tracking vehicles; researched projectile shock wave characterization.</li> <li>-Investigated properties of SiC including electronic impurities for compensation of epitaxial layers, high resistivity substrate materials and PIN diode limiters as a basis for developing robust electronics.</li> <li>-Investigated the underlying physical principles for better hybridization as well as different material issues and polarization issues for designing single polarization lasers.</li> </ul> <p>Total 1685</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1778 -Incorporate on-chip processing and optical pre-processing on two-dimensional photodetector arrays for improved performance and functionality.</li> <li>-Design photonic-based integrated optic processor for optical control of microwaves and phased arrays.</li> <li>-Research photonic implementations of automatic target recognition (ATR) and other signal processing algorithms.</li> <li>-Characterize beam fanning limiter performance.</li> <li>-Evaluate UV acoustic-optical tunable filter (AOTF) for remote sensing applications.</li> </ul> |                   |                     |                     |   |                     |                     |                     |                               |                     |            |  |
| Project AH44   |                   |                     |                     | Page 12 of 66 Pages   |                     |                     |                     | Exhibit R-2 (PE 0601102A)     |                     |            |  |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>                   | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b>   | PROJECT<br><b>AH44</b>       |
| <b>FY 1997 Planned Program: (continued)</b>                    |  |                              |
|  | -Investigate different semiconductor structures and physical/material properties. Utilize this knowledge to design and demonstrate high density smart-pixels and other concepts and devices for 2D optical processing, image processing, and for aided target recognition. |                              |
| • 1469   | -Conduct research focused on new data/image compression techniques to offset the growing demands for additional bandwidth in the distributed interactive simulation (DIS) environment.   |                              |
|  | -Investigate techniques to automatically establish seamless connections between physical models in constructive, virtual, and live simulation.   |                              |
| 37   | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                              |
| Total  | 3284   |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 526  | - Implement and analyze potential solutions designed in previous fiscal year, producing a partially "fuzzified" system prototype.  |                              |
|  | - Include algorithms for structured data text and adapting object technology to standards-based electronic data interchange (edi) in multimedia exchange model.  |                              |
| • 1020   | - Develop computational algorithms and intelligent agents for function and process coordinated overlay of intelligence and logistics synthetic environments on the synthetic sand table environment.   |                              |
|  | - Develop infrastructure to support high level architecture in a synthetic, DIS environment.   |                              |
| • 1256   | - Investigate digital - optical processing for correction of common aberrations.   |                              |
|  | - Design sensor protection prototype.  |                              |
| • 600  | -Integrate active and passive optical components for free space and guided wave communications and sensor processing.  |                              |
|  | -Ingrate novel passive optic elements and digitals processing for advanced visible and infrared imaging.   |                              |
| • 1500   | -Conduct two data collections with the ARL boom synthetic aperture radar (SAR) in differing clutter environments. Co-locate a FLIR with the BoomSAR during at least one of the data collection efforts.  |                              |
| Total  | 4902   |                              |
| <b>FY 1999 Planned Program:</b>                                |  |                              |
| • 562  | - Continue the application of fuzzy logic techniques on a much larger scale by extending the partial solution(s) developed previously to a complete solution, producing a fully functional system prototype.   |                              |
|  | - Insert multimedia application-to-application knowledge exchange technology into an operational data exchange system and validate multimedia exchange model.  |                              |
| • 1044   | - Incorporate high fidelity physical vulnerability models into the synthetic environment for STOW 2000.  |                              |
|  | - Develop mission planning and rehearsal capability for the virtual sand table at the entity level.  |                              |
| Project AH44   |  |                              |
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| Exhibit R-2 (PE 0601102A)                                      |  |                              |

| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AH44</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 1098 - Integrate and demonstrate digital optical processing for correction of aberration and focus independent depth of field.<br/>- Design and fabricate diffractive optical elements (DOEs) with sub-micron features.<br/>- Demonstrate realistic motion 3D hologram.</li> <li>• 843 - Demonstrate advanced sensor processing and communication using integrated optical components.</li> <li>• 1500 - Develop techniques to exploit the unique response from metal and dielectric mines. Begin to incorporate discrimination techniques in previously developed ARL detection framework.</li> </ul> <p>Total 5047</p>  |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1696</td> <td style="text-align: center;">3385</td> <td style="text-align: center;">3465</td> <td style="text-align: center;">3561</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1742</td> <td style="text-align: center;">3284</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-57</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1685</td> <td style="text-align: center;">3284</td> <td style="text-align: center;">4902</td> <td style="text-align: center;">5047</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding increases in FY 1998 and 1999 reflect decision to increase investment in basic research related to countermine.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1696 | 3385 | 3465 | 3561 | Appropriated Value | 1742 | 3284 |  |  | Adjustments to Appropriated Value | -57 |  |  |  | FY 1998 Pres Bud Request | 1685 | 3284 | 4902 | 5047 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 1696  | 3385                          | 3465           | 3561           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 1742  | 3284                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -57   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 1685  | 3284                          | 4902           | 5047           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Project AH44  | <i>Page 14 of 66 Pages</i>  | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     |                     | DATE<br><b>February 1997</b> |            |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|---------------------|------------------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                           |                     |                     | PROJECT<br><b>AH45</b>       |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete          | Total Cost |
| AH45 Air Mobility   | 1829              | 1809                | 2191                | 2280   | 2385                | 2477                      | 2528                | 2584                | Continuing                   | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> Basic research in aerodynamics and avionics as applied to rotary wing aircraft. Analysis, code development, and test and evaluation are conducted on rotor unique aerodynamics, dynamics, performance, and aircraft performance and acoustics. Efforts in avionics are focused on antenna modeling and advanced display concepts.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1829 -Tested and evaluated smart airfoils and stall-free model rotors.</li> <li style="padding-left: 20px;">-Investigated rotor active control techniques for acoustic propagation.</li> <li style="padding-left: 20px;">-Conducted interactional aero-vibration code validation focused studies.</li> <li style="padding-left: 20px;">-Extended antenna codes to handle multiple composite materials.</li> </ul> <p>Total 1829</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1765 -Expand smart airfoil results to revolutionary envelope expansion for rotorcraft.</li> <li style="padding-left: 20px;">-Initiate the combination of aeroacoustic theory with interactional aero computational fluid dynamics (CFD) codes.</li> <li>• 44 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1809</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2191 - Complete scale model wind tunnel testing with a pneumatically actuated, trailing edge flap for high lift.</li> <li style="padding-left: 20px;">- Develop and validate the HELIX-II-2, which includes accelerated vorticity embedding method to prevent numerical dissipation problems.</li> <li style="padding-left: 20px;">- Develop advanced concepts for aeroelastic couplings to enable damperless/bearingless rotor systems by eliminating the need for auxiliary lead lag dampers to control ground/air resonance.</li> <li style="padding-left: 20px;">- Develop a grid-adaptive, unstructured overset scheme for the OVERFLOW code to improve the resolution of the rotor wake system.</li> <li style="padding-left: 20px;">- Integrate a panel methodology into an integrated aeromechanics analysis to model aerodynamic influence of fuselage and wing/empennage.</li> </ul> <p>Total 2191</p> |                   |                     |                     |  |                     |                           |                     |                     |                              |            |
| Project AH45  |                   |                     | Page 15 of 66 Pages |  |                     | Exhibit R-2 (PE 0601102A) |                     |                     |                              |            |



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|--|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> | PROJECT<br><b>AH45</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2280 - Develop integral structure/actuator concepts for application to practical multi-controller active, on-blade controlled rotor systems for low vibration rotorcraft.</li> <li style="padding-left: 40px;">- Design and fabricate a scale model equipped with oscillatory blowing to control flow separation.</li> <li style="padding-left: 40px;">- Integrate pressure disk methodology in OVERFLOW to model the effects of a rotor disk on a complex rotorcraft fuselage.</li> <li style="padding-left: 40px;">- Fabricate and test an isolated, instrumented baseline rotor for increased payload, reduced noise and vibration.</li> </ul> <p>Total            2280</p>   |  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1979</td> <td style="text-align: center;">2152</td> <td style="text-align: center;">2257</td> <td style="text-align: center;">2361</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2034</td> <td style="text-align: center;">1809</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-205</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1829</td> <td style="text-align: center;">1809</td> <td style="text-align: center;">2191</td> <td style="text-align: center;">2280</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Congressional reduction of basic research activities.</p> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1979 | 2152 | 2257 | 2361 | Appropriated Value | 2034 | 1809 |  |  | Adjustments to Appropriated Value | -205 |  |  |  | FY 1998 Pres Bud Request | 1829 | 1809 | 2191 | 2280 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 1979   | 2152                         | 2257           | 2361           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 2034   | 1809                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -205   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 1829   | 1809                         | 2191           | 2280           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AH45   | <i>Page 16 of 66 Pages</i>                                       | Exhibit R-2 (PE 0601102A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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|--|------------------------------|

|   |   |                               |
|---|---|-------------------------------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AH47</b> |
|---|---|-------------------------------|

| COST <i>(In Thousands)</i>    | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|-------------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| AH47 Applied Physics Research | 2613              | 2751                | 3083                | 3207                | 3359                | 3489                | 3564                | 3688                | Continuing          | Continuing |

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

**FY 1996 Accomplishments:**

- 2613 -Performed research on novel integrated, loss-less optical splitter/phase shifter necessary for lightweight, low cost highly functional integrated photonic devices critical to Army communications-on-the-move systems and for fiber optic gyroscopes for missile guidance and global positioning. Investigated other concepts for higher functionality.
- Designed and demonstrated 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.
- Continued research on spatial light modulator arrays necessary to implement fast optical processing architectures for automatic target recognition applications. Investigated issues involving optimization, novel functionalities and physical limitations of such devices.
- Increased operating temperature of an infrared hot-electron transistor (IHET) beyond 77 degrees K in the 10 micron range and optimized the IHET structure capable of detecting infrared radiation in the 15 micron range.
- Designed 2nd generation permanent magnet bias source for a 140 Ghz microwave tube and transfer to industry.

Total 2613

**FY 1997 Planned Program:**

- 2750 -Perform theoretical and experimental research to develop quantum cascade lasers in both As- and Sb-based materials systems.
- Perform research on GaSb/AlSb/InAs structures for novel broken-gap intersubband and interband emitter/detector structures.
- Analyze GPS and laser ranging data from GPS satellites to determine GPS accuracy (with NASA and University of Maryland).
- Perform research on integrated photonic laser/shifter/receiver to extend the capabilities of battlefield digitization.
- Demonstrate tunable waveguide modulator/detector at 800 nm.
- Design, fabricate, and test polarization independent waveguide modulator for Army communication systems.

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|--|---|-------------------------------|----------------|---------------------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |   | DATE<br><b>February 1997</b>  |                |                           |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>            | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b>   |                               |                |                           |
|  |   | <b>PROJECT</b><br><b>AH47</b> |                |                           |
| <b>FY 1997 Planned Program: (continued)</b>                    |   |                               |                |                           |
|  | -Investigate vertical cavity surface emitting laser (VCSEL) with strained active regions grown on (111)-oriented GaAs and compare their performance with (100)-oriented devices.      |                               |                |                           |
|  | -Use VCSEL-based smart pixels on silicon and GaAs circuits to perform simple signal distribution tasks.   |                               |                |                           |
|  | -Develop 815 nanometer reflection modulator for LADAR program.  |                               |                |                           |
| 1  | -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                               |                |                           |
| <b>Total</b>   | <b>2751</b>   |                               |                |                           |
| <b>FY 1998 Planned Program:</b>                                |   |                               |                |                           |
| • 3083   | -Determine the capability of vicinal step growth to fabricate quantum wires. Critically evaluate the potential of such quantum wires for device applications.                         |                               |                |                           |
|  | -Investigate novel semiconductor structures and their basic properties for applications in next generation devices  |                               |                |                           |
|  | -Investigate microcavity effects for producing more efficient VCSELs and LEDs.  |                               |                |                           |
|  | -Develop relativistically correct model for GPS within the framework of general relativity.   |                               |                |                           |
|  | -Design and test anisotropically strained QW THz radiation detector for biological/chemical detection and radar ranging.  |                               |                |                           |
|  | -Fabricate and test GaSb/AlSb/InAs based broken-gap interband and intersubband emitter/detector devices.  |                               |                |                           |
| <b>Total</b>   | <b>3083</b>   |                               |                |                           |
| <b>FY 1999 Planned Program:</b>                                |   |                               |                |                           |
| • 3207   | -Demonstrate magnetic resonance microscopy concepts developed in collaboration with Johns Hopkins Applied Physics Lab under the microelectronics research cooperative program (MRCP). |                               |                |                           |
|  | -Develop quantum-wire based optoelectronic device structures.   |                               |                |                           |
|  | -Develop techniques for fabricating coulomb-blockade tunneling structures for high speed switching applications.  |                               |                |                           |
|  | -Develop VCSEL structures that exploit microcavity effects to enhance device performance.   |                               |                |                           |
|  | -Develop improvements to GPS positioning algorithms for smart munitions.  |                               |                |                           |
|  | -Develop VCSEL arrays with reduced polarization switching noise for signal processing applications.   |                               |                |                           |
| <b>Total</b>   | <b>3207</b>   |                               |                |                           |
| <b>B. Project Change Summary</b>                               |   |                               |                |                           |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u>            |
| FY 1997 President's Budget                                     | 2582  | 3025                          | 3155           | 3322                      |
| Appropriated Value   | 2653  | 2751                          |                |                           |
| Adjustments to Appropriated Value                              | -40   |                               |                |                           |
| FY 1998 Pres Bud Request                                       | 2613  | 2751                          | 3083           | 3207                      |
| Project AH47   | <i>Page 18 of 66 Pages</i>  |                               |                | Exhibit R-2 (PE 0601102A) |

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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|---------------------|------------------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           |                     | PROJECT<br><b>AH48</b>       |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate | Cost to<br>Complete          | Total Cost |
| AH48 Battlespace Information & Communications Res  | 0                 | 6729                | 6199                | 7925   | 6988                | 6417                | 8617                      | 8110                | Continuing                   | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project performs basic research in three technology areas: simulations, intelligent systems, and information survivability and vulnerability analysis. The project also supports the Army High Performance Computer Resource Center at the University of Minnesota.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1817 - Demonstrate modeling techniques for fluid-body interactions including adaptive gridding and multi-body dynamics, establish 3D modeling capability for free surface flows in waterways, and demonstrate modeling techniques for fluid flow through fractured rock for radioactive waste cleanup and hazard assessment.</li> <li>• 4755 - Investigate techniques that provide secure and survivable technologies, networks, and architectures. Initiate development of robust, adaptive, and fault tolerant networking protocols. Investigate secure techniques for mobile host protocols.<br/>- Investigate the application of software intelligent agents to C4I applications. Initiate the development of infrastructure for survivability and C4I software agents including human-agent, agent-agent, and agent-database interactions.</li> <li>• 157 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 6729</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4515 - Continue refinement of selected techniques that improve security and survivability technologies, networks, and architectures. Develop and simulate secure mobility management techniques for mobile host protocols that support dynamic host reconfiguration.<br/>- Develop and simulate software intelligent agents for information system vulnerability assessment and other C4I applications.</li> <li>• 1684 - Continue development of adaptive gridding, mesh moving, and multi-body modeling techniques. Apply these techniques to model paratrooper exit from large transport aircraft.<br/>- Continue development of modeling techniques for multi-phase fluid flow in porous media including biodegradation of contaminants.<br/>- Develop computational modeling techniques for the sintering process for manufacturer of ceramic crystal materials.</li> </ul> <p>Total 6199</p> |                   |                     |                     |  |                     |                     |                           |                     |                              |            |
| Project AH48   |                   |                     | Page 19 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                     |                              |            |

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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|---|-------|-------|-------|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AH48</b> |                |                |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6261 - Demonstrate and validate secure mobility management techniques for mobile host protocols that support dynamic host configurations.<br/>- Demonstrate and validate software intelligent agents for vulnerability assessment and other C4I applications.</li> <li>• 1664 - Demonstrate numerical methods for real-time high performance geographic information systems which exploit scaleable computing architectures.<br/>- Develop highly parallel solvers for sparse linear systems for applications to solve problems in fluid flow, structural mechanics, electromagnetics and heat transfer.<br/>- Exploit emerging scaleable computing technologies at the Army High Performance Computing Research Center (AHPCRC).<br/>- Demonstrate real-time, scaleable algorithms for vehicle multi-body simulations.<br/>- Extend development of modeling advanced materials processing techniques of ceramic crystals.</li> </ul> <p>Total            7925</p>  |   |                               |                |                |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">11499</td> <td style="text-align: center;">12805</td> <td style="text-align: center;">13019</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">0</td> <td style="text-align: center;">6729</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">6729</td> <td style="text-align: center;">6199</td> <td style="text-align: center;">7925</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 - Congressional reduction of basic research activities.<br/>FY 1998/FY1999 - Funds reprogrammed for higher priority requirements.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 11499 | 12805 | 13019 | Appropriated Value | 0 | 6729 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 6729 | 6199 | 7925 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |
| FY 1997 President's Budget  | 0   | 11499                         | 12805          | 13019          |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |
| Appropriated Value  | 0   | 6729                          |                |                |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |
| Adjustments to Appropriated Value   |   |                               |                |                |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |
| FY 1998 Pres Bud Request  | 0   | 6729                          | 6199           | 7925           |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |
| <p>Project AH48 <span style="float: right;">Page 20 of 66 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0601102A)</span></p>   |   |                               |                |                |                |                |                |                            |   |       |       |       |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                            |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | <b>PROJECT</b><br><b>AH52</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH52 Equipment for the Soldier  | 941               | 831                 | 1014                       | 1056  | 1105                | 1145                | 1167                      | 1192                          | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> Basic research focused on three core technology areas critical to the Soldier System: biotechnology, polymer science/textile technology and food technology. Research is targeted toward enhancing the mission performance, survivability, and sustainability of the soldier by advancing the state of the art in defense against battlefield threats and hazards such as ballistics, chemical agents, lasers, environmental extremes, and shortfalls in the availability of nutritious, satisfying rations essential to the health and well-being of soldiers.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 351 -Characterized self-assembly of next-generation protein building blocks for development of new biosensors for laser eye protection.<br/>-Probed intestinal immune system for targeted delivery of bioactive nutrients to improve immune response.<br/>-Quantified constituent distribution affecting stability and texture of complex carbohydrate/protein ration components as a basis for enhancing ration shelf-life in the field.<br/>-Characterized nonlinear optical properties of polymer-inorganic composites for laser eye protection applications.</li> <li>• 590 -Performed mathematical modeling and experimental studies on textile systems as a means of understanding complex failure mechanisms.<br/>-Improved breaking stress of PVA fibers through incremental fiber drawing for ballistic protection applications.<br/>-Filed patents on biosensor arrays which provide technology for development of unique advanced materials for ballistic laser eye protection, counter surveillance and conducting ceramics.<br/>-Investigated thin-film technologies to demonstrate self-assembling for controlled permeation for chemical/biological (CB) defense applications.<br/>-Determined the physical properties of newly modified polymers for ballistic applications and measured ballistic performance using mechanics testing.<br/>-Investigated mechanisms and yields of intrinsic chemical markers for assurance of improved thermal ration processes.</li> </ul> <p>Total 941</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 811 -Explore protective barriers based on "active" membrane systems leading to new methods to protect the soldier from chemical threats.<br/>-Initiate molecular modeling of polymer interphases leading to the development of polymeric films and fibers with improved mechanical properties for ballistic and chemical agent protection.<br/>-Design advanced ceramics for small arms protection at the molecular level to control crystal structure and improve performance.<br/>-Initiate effort to develop new composite architectures for multifunctional membranes that exclude the transport of organic vapors, yielding an increased level of protection and comfort for chemical protective clothing.</li> </ul> |                   |                     |                            |   |                     |                     |                           |                               |                     |            |
| Project AH52  |                   |                     | <i>Page 21 of 66 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0601102A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |     |     |      |      |                    |     |     |  |  |                                   |     |  |  |  |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-----|-----|------|------|--------------------|-----|-----|--|--|-----------------------------------|-----|--|--|--|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AH52</b> |                |                |                |                |                |                            |     |     |      |      |                    |     |     |  |  |                                   |     |  |  |  |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>-Initiate fabrication of conducting electroconductive polymer and photoresponsive protein composites with potential application to various optical devices, including individual laser eye protection.</li> <li>- Investigate various plasticizers/moisture binders to ameliorate textural changes during storage of intermediate moisture ration items.</li> <li>- Incorporate self-assembly techniques into newly developed ballistic silk fibers for further refinement of properties and characteristics for ballistic protection.</li> <li>- Continue experimentally guided analytical work on fibers, fabrics, and fiber-resin systems for application to soldier survivability items.</li> </ul> <ul style="list-style-type: none"> <li>• 20 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 831</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1014 - Bioengineer pore materials as second step in development of selectively permeable membranes for personnel protection against chemical threats.</li> <li>- Characterize polymeric "interphases" for optimization of ballistic and chemical agent protective properties.</li> <li>- Use thin-film technology, for the design of advanced ceramics, to control the organic-inorganic interfaces leading to lightweight ceramics for personnel protection.</li> <li>- Leveraging the multidisciplinary university research initiative (MURI) for "functionally tailored fibers and fabrics", use the new eletrospinning technology to produce new membranes for chemical protective clothing.</li> <li>- Immobilize proteins into assemblies to maximize signal transduction, providing technology for new materials for agile laser eye protection.</li> </ul> <p>Total 1014</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1056 - Engineer a triggering device for activating selectively permeable membranes for personnel chemical protection.</li> <li>- Form larger samples of advanced ceramics for lightweight ballistic protection under optimal conditions to establish technology for producibility and for materials properties characterization.</li> <li>- Conduct preliminary screening of new materials using "electrospinalcing" technology for the production of "seamless" chemical protective clothing.</li> </ul> <p>Total 1056</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">964</td> <td style="text-align: center;">988</td> <td style="text-align: center;">1006</td> <td style="text-align: center;">1030</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">991</td> <td style="text-align: center;">831</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-50</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 964 | 988 | 1006 | 1030 | Appropriated Value | 991 | 831 |  |  | Adjustments to Appropriated Value | -50 |  |  |  |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |     |     |      |      |                    |     |     |  |  |                                   |     |  |  |  |
| FY 1997 President's Budget  | 964   | 988                           | 1006           | 1030           |                |                |                |                            |     |     |      |      |                    |     |     |  |  |                                   |     |  |  |  |
| Appropriated Value  | 991   | 831                           |                |                |                |                |                |                            |     |     |      |      |                    |     |     |  |  |                                   |     |  |  |  |
| Adjustments to Appropriated Value   | -50   |                               |                |                |                |                |                |                            |     |     |      |      |                    |     |     |  |  |                                   |     |  |  |  |
| Project AH52  | Page 22 of 66 Pages   | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |     |     |      |      |                    |     |     |  |  |                                   |     |  |  |  |

DATE  
**February 1997**

BUDGET ACTIVITY  
**1 - Basic Research**

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

**B. Project Change Summary**

FY 1998 Pres Bud Request

| <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|----------------|----------------|----------------|----------------|
| 941            | 831            | 1014           | 1056           |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>BH57</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| BH57 Scientific Problems with Military Applications   | 53307             | 46812               | 58174               | 56475  | 56343               | 57313               | 56697                     | 58230                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 (mechanics, 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 120 institutions in 41 states. Additionally, 5% of Army funding of university research is committed to Historically Black Colleges and Universities/Minority Institutions (HBCU/MI).</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 27056 -Conducted materials research on ultrahard diamond-like coatings for recoilless gun components.<br/>-Advanced research in electronic and optoelectronic structures for ultrafast processing with minimum energy dissipation for command and control on the digital battlefield.<br/>-Developed techniques for coherent infrared imaging, millimeter wave imaging, multiple wavelength detectors and temporal imaging to improve visibility.<br/>-Conducted biosciences research to develop microbiological and biochemical characterization of cells to break down military materiel waste.</li> <li>• 26251 -Designed adaptive intelligent control systems for multivariable and nonlinear systems with application to real-time implementation in embedded systems.<br/>-Conducted research in atmospheric sciences for accurate prediction of electromagnetic wave scattering cross section in the atmosphere; advanced terrestrial sciences knowledge of hydrologic runoff processes for large floods.<br/>-Developed "smart" structures concepts to suppress vibrations, reduce noise levels, and modify structural shapes of rotorcraft.<br/>-Provided fundamental information on energetic materials, ignition and combustion for ballistic models and developed elastomeric materials for lower cost, longer life, high performance plastics.</li> </ul> <p>Total 53307</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project BH57  |                   |                     | Page 23 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>                   | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b>   | PROJECT<br><b>BH57</b>       |
| <b>FY 1997 Planned Program:</b>                                |  |                              |
| • 23800  | -Advance materials research in glassy metallic alloys for lightweight, ultrastrong composites with application to combat vehicle structures.<br>-Advance research in wireless communications, signal processing and efficient RF transmit/receive modules to enhance throughput of information supporting command and control for Force XXI.<br>-Advance research in mechanics to demonstrate a time-dependent, 3-D model of fuel injection, ignition and combustion dynamics to identify optimal ranges of engine operation.<br>-Increase the understanding of behavior of soil and cold climate materials in response to military operations with emphasis on vehicle-terrain interactions and interaction of precipitation with the ground. |                              |
| • 22032  | -Advance research in chemistry to create a new synthetic route to recyclable polymers with tailored properties.<br>-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 for battle management.<br>-Advance biosciences research including deriving a novel photochromic material from bacteriorhodopsin.<br>-Explore nonlinear optical phenomena occurring in liquid crystal optical fibers for possible application for pulse compression, frequency conversion and other electro-optical applications.   |                              |
| • 980  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                              |
| Total  | 46812  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 26403  | - Advance electronics research to develop quasi-optical circuits with high efficiency and high power at high millimeter wave frequencies.<br>- Advance materials research to provide improved microstructural control of ceramics suitable for armor applications.<br>- Advance physics research to exploit the properties of nanometer-sized clusters of atoms to construct materials with unique functionality.  |                              |
| • 31771  | - Advance chemistry research in dendrimers and hyperbranched polymers as a new class of nanoscopic building blocks.<br>- Advance research in the area of micro-mechanical mechanisms governing friction and wear of high temperature surfaces in engines.<br>- Advance knowledge-base sciences in critical issues of complex reasoning and machine learning for multimedia digital information environments.<br>- Advance biological sciences research in gene expression to determine the neural mechanisms that facilitate alertness and attention.  |                              |
| Total  | 58174  |                              |
| <b>FY 1999 Planned Program:</b>                                |  |                              |
| • 25900  | - Design electromagnetic adaptive materials and structures for sensing and monitoring applications and for camouflage.<br>- Develop 3-D microelectromechanical devices from high strength and high temperature materials to re-engineer heat engines at the micro level.<br>- Integrate analytical and numerical techniques of structural modeling with computer graphics and visualization methods for "smart" materials applications.  |                              |
| Project BH57   |  |                              |
| Page 24 of 66 Pages  |  |                              |
| Exhibit R-2 (PE 0601102A)                                      |  |                              |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|-------|--|--|--|--------------------------|-------|-------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>BH57</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 30575 - Develop new antenna structures to optimize the new quasi-optical architectures.</li> <li>- Advance biosciences research to develop mechanisms by which enzymes from thermophilic microorganisms can tolerate extreme temperatures.</li> <li>- Conduct research in quantum computational analysis to develop revolutionary devices which can solve several types of "unsolvable" problems.</li> <li>- Develop a wide range of metal matrix composites using modified models of mismatched induced superplasticity.</li> <li>- Advance chemistry research to develop vesicles which can simultaneously visually identify the exact location of chemical agents and also destroy them.</li> </ul> <p>Total        56475</p>  |   |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">54546</td> <td style="text-align: center;">55707</td> <td style="text-align: center;">57961</td> <td style="text-align: center;">59299</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">56084</td> <td style="text-align: center;">46812</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-2777</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">53307</td> <td style="text-align: center;">46812</td> <td style="text-align: center;">58174</td> <td style="text-align: center;">56475</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Congressional reduction of basic research activities.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 54546 | 55707 | 57961 | 59299 | Appropriated Value | 56084 | 46812 |  |  | Adjustments to Appropriated Value | -2777 |  |  |  | FY 1998 Pres Bud Request | 53307 | 46812 | 58174 | 56475 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
| FY 1997 President's Budget  | 54546   | 55707                         | 57961          | 59299          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
| Appropriated Value  | 56084   | 46812                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
| Adjustments to Appropriated Value   | -2777   |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
| FY 1998 Pres Bud Request  | 53307   | 46812                         | 58174          | 56475          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |
| Project BH57  | <i>Page 25 of 66 Pages</i>  | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |       |       |       |       |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|-------------------------------|---------------------|------------|
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| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                     | <b>PROJECT</b><br><b>AH66</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH66 Advanced Structures Research   | 1257              | 1287                | 1405                | 1465  | 1532                | 1590                | 1622                | 1669                          | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification</u></b> : This project is a joint Army/NASA effort that includes structures technology research into: structural integrity analyses; failure criteria; inspection methods which address fundamental technology deficiencies in both metallic and composite Army rotorcraft structures; use of composite materials in the design and control of structures through structural tailoring techniques; rotorcraft aeroelastic and aeromechanical stability; helicopter vibration (rotating and fixed systems); design and analyses of composite structures with crashworthiness as a goal; and the control of aircraft interior noise levels. These areas have application to the development of design tools for improved helicopter structures and dynamic response. This structures-focused technology includes reductions in vehicle vibratory loads, improved vehicle stability, advanced fatigue methodologies for metallic structures, improved composites technology throughout the vehicle, and long-term development of an integrated stress-strength-inspection technology. These technologies will extend service life, reduce maintenance costs, and enhance the durability of existing and future Army vehicles. The improved tools and methods will enable the design and use of composite structures that can better address the cost, weight, performance, and dynamic interaction requirements of future platforms, and ultimately result in safer, more affordable vehicles. As agreed under Project Reliance, this is the only project for rotorcraft and ground structures basic research within the DoD. No related effort is being conducted within DoD.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1257 - Performed numerical simulation study of active blade twist actuation for three conceptual piezoelectric helicopter blade designs, and correlated with CAMRAD -II analysis.</li> <li>- Enhanced UMARC tilt rotor stability prediction with independent rotor-speed degree of freedom, and engine/drive-system dynamics modifications.</li> <li>- Incorporated size effects in failure theories to predict large deformation damage, and published two papers.</li> <li>- Conducted vertical drop test of Lear Fan fuselage section with modified energy absorbing composite subfloor, and correlated with DYCAST analysis.</li> <li>-Successfully evaluated nearfield acoustic holography for improved interior noise measurement capability in aircraft fuselage section, using analytical Green's function.</li> <li>- ASTM double cantilever beam (DCB) draft standard accepted by international standards organization (ISO).</li> <li>- Developed 3D finite element analysis for local delamination in tapered composite laminates subjected to combined tension-torsion loads.</li> <li>- Performed low velocity impact tests on sandwich panels to establish threshold of visible damage.</li> <li>- Conducted parametric studies to assess propagation characteristics of cracks in fuselage panels.</li> <li>-Conducted 2D finite element analysis (FEA) of as-produced composite rodpack microstructure to correlate local stresses with pull-off test results.</li> </ul> <p>Total            1257</p> |                   |                     |                     |   |                     |                     |                     |                               |                     |            |
| Project AH66  |                   |                     |                     | <i>Page 26 of 66 Pages</i>  |                     |                     |                     | Exhibit R-2 (PE 0601102A)     |                     |            |

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|--|---|---------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE                       | PROJECT                   |
| <b>1 - Basic Research</b>  | <b>0601102A Defense Research Sciences</b> | <b>AH66</b>               |
| <b>FY 1997 Planned Program:</b>  |   |                           |
| <ul style="list-style-type: none"> <li>• 1284 - Enhance the piezoelectric blade aeroelasticity analytical model and develop control laws to reduce blade vibrations.</li> <li>- Conduct CAMRAD II analyses to verify the load reduction potential of the active rotor system preliminary design.</li> <li>- Design, fabricate and bench test a prototype of a twist actuated actively controlled rotor blade as a preliminary evaluation for a complete rotor system.</li> <li>- Evaluate CAMRAD-II's ability to accurately predict rotor unsteady loads, and use it to design a rotor system that isolates structural properties most critical to rotor loads.</li> <li>- Conduct DYCAST analysis of assembled Lear Fan energy absorbing subfloor section to define the load transfer from the seat rail to the composite beams.</li> <li>- Refine KRASH model of full-scale Lear Fan aircraft to incorporate energy absorbing subfloor and conduct analysis prior to crash test.</li> <li>- Perform detailed evaluation of actuator selection technique for active interior noise control on a trimmed aircraft fuselage model.</li> <li>- Refine stationary nearfield acoustic holography formulation to include floor, and flight test evaluation in commuter class aircraft.</li> <li>- Publish ASTM test standard for Mode I DCB fatigue delamination onset of tapered composite laminates.</li> <li>- Conduct low velocity impact tests for thick composites made from glass and glass/ceramic hybrids.</li> <li>- Apply 3D FEA to calculate delamination fracture toughness criteria in tapered composite laminates.</li> <li>- Correlate fracture mechanics total life models which incorporate rotorcraft load interaction effects.</li> <li>- Develop finite element models (FEMs) of center-cracked stiffened panels to predict influence of rivet stiffness crack arrest.</li> <li>3 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> |   |                           |
| Total  | 1287                                      |                           |
| <b>FY 1998 Planned Program:</b>  |   |                           |
| <ul style="list-style-type: none"> <li>• 1405 - Complete design and fabrication of actively controlled rotor system with integral active twist control, make required modifications to the ARES testbed, and conduct hover test.</li> <li>- Conduct CAMRAD-II analyses to guide wind tunnel experiments of active twist rotor blades with a focus on the development of control law definition.</li> <li>- Complete analytical investigation of effects of rotor blade aeroelastic parameters on rotor loads, and design model baseline rotor blades.</li> <li>- Modify comprehensive tilt rotor analysis to include capability of predicting stability of free-flight system including antisymmetric wing modes.</li> <li>- Perform aeroelastic response studies of tilt rotor systems with active controls for stability augmentation.</li> <li>- Publish results of experiments to study scaling effects in tensile coupons under large deformation.</li> <li>- Complete draft of peer reviewed paper on state-of-the-art in scaling of composite materials and structures</li> <li>- Retrofit second full-scale Lear Fan aircraft with energy absorbing subfloor beams, and conduct a full-scale crash test.</li> <li>- Validate damage resistance and residual strength models for low velocity impact of stitched composite panels.</li> <li>- Perform parametric studies to develop design criteria for rotorcraft flexbeam geometry anomalies.</li> </ul>  |   |                           |
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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AH66</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Validate 3D FEA composite flexbeam strength and fatigue life predictions for combined tension/torsion loading.</li> <li>- Investigate benefits of secondary adhesive bonds and 3D reinforcements to increase composite stringer strength.</li> <li>- Conduct parametric studies to determine influence of flexbeam layup and material form on strength and fatigue durability.</li> <li>- Evaluate structural parameters to understand and control crack growth geometry in stiffened panels.</li> <li>-Conduct crack-growth tests on multi-hole panel to validate small crack failure criteria.</li> </ul> <p>Total            1405</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            1465 - Conduct hover and forward flight testing of twist actuated active rotor system in the Helicopter Hover Facility and the Transonic Dynamics Tunnel.</li> <li>                 - Incorporate active control and smart material analytical models into comprehensive tilt rotor analysis, and correlate with tests of an actively-controlled stability augmentation system.</li> <li>                 - Correlate KRASH model of the Lear Fan full-scale aircraft with data from crash test, and publish paper at American Helicopter Society (AHS) Forum.</li> <li>                 - Publish Mode II and Mixed Mode test standards to measure delamination onset and fracture toughness of composite laminates.</li> <li>                 - Develop probabilistic method for analyzing low velocity impact resistant in composite panels.</li> <li>                 - Develop accept/reject criteria for flexbeams with manufacturing flaws.</li> <li>                 - Develop fatigue analysis for arbitrary flexbeam layup under combined tension/torsion loads.</li> <li>                 - Expand fatigue life predictive methods to use probabilistic distribution of flaw sizes to establish upper and lower failure bounds.</li> </ul> <p>Total            1465</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1268</td> <td style="text-align: center;">1372</td> <td style="text-align: center;">1391</td> <td style="text-align: center;">1420</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1302</td> <td style="text-align: center;">1287</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-45</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1257</td> <td style="text-align: center;">1287</td> <td style="text-align: center;">1405</td> <td style="text-align: center;">1465</td> </tr> </tbody> </table> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1268 | 1372 | 1391 | 1420 | Appropriated Value | 1302 | 1287 |  |  | Adjustments to Appropriated Value | -45 |  |  |  | FY 1998 Pres Bud Request | 1257 | 1287 | 1405 | 1465 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 1268  | 1372                          | 1391           | 1420           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 1302  | 1287                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -45   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 1257  | 1287                          | 1405           | 1465           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Project AH66  |   | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>BH67</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| BH67 Environmental Research - Army Material Cmd   | 3811              | 4798                | 5709                | 4917   | 5575                | 5598                | 4603                      | 4795                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project focuses basic research on innovative technologies for both industrial pollution prevention (P2) that directly supports the Army industrial base and for non-stockpile chemical warfare (CW) site remediation. The objective of the pollution prevention work is to invest in next generation manufacturing, maintenance, and disposal methods that will result in significantly reducing the usage of hazardous and toxic substances and their associated costs. The goal is to decrease the overall life-cycle costs of Army systems by 15-30% through the application of advanced pollution prevention technologies. The CW remediation efforts concentrate on the application of biotechnology in the characterization and physical clean-up of agent-contaminated soils and groundwater. The goal is to reduce the cost of remediating a site by at least 50% versus the use of conventional methods. Pollution prevention thrusts include: environmentally acceptable advanced non-radioactive, non-toxic and lightweight alternative structural materials to enhance weapon system performance; substitutes for ozone-depleting chemicals as solvents, refrigerants, and firefighting agents for military unique applications; energetic synthesis and process improvements to eliminate the use of hazardous materials and to minimize the generation of wastes from manufacturing operations; and surface protection alternatives to hazardous paints, cadmium, chromium, and chromate conversion metal and composite surfaces. CW thrusts include establishing the ecotoxicity of CW compounds, environmental fate and effect of CW compounds in soils and biodegradation of CW compounds. This project is linked to the Tri-Service Environmental Quality Research and Development Strategic Plan and addresses environmental technology requirements included in that plan.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1914 - Applied genetic engineering techniques to both synthesis and bioconversion applications as a means for process optimization.               <ul style="list-style-type: none"> <li>- Completed all basic research work in aqueous based degreasing and lightweight protective ceramics and initiated transition of all programs to applied research.</li> <li>- Developed kinetic models for atmospheric fate of chloroflouorocarbons (CFx) and other species for most promising halon alternative compounds (HACs); and performed quantum chemical simulations of infrared spectra for HAC decomposition products.</li> </ul> </li> <li>• 1897 - Conducted laboratory validations of plant studies and evaluated aquatic microcosm systems.               <ul style="list-style-type: none"> <li>- Used the cytosensor to monitor status of soil microbial consortia.</li> <li>- Optimized biodegradative systems for mustard and sarin and evaluated biosurfactant/nutrient addition treatments for remediation of soils.</li> </ul> </li> </ul> <p>Total 3811</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3472 - Synthesize cyclic nitramine using enzymatic methods. Transition enzymatic work into "Green Energetics" program.               <ul style="list-style-type: none"> <li>- Complete all basic research work in aqueous processing of fibers and composites and initiate technology transfer to exploratory development.</li> <li>- Develop biotechnological methods to treat chemical warfare (CW) contaminated soil, determine CW agent fate, and assess environmental risk.</li> </ul> </li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project BH67  |                   |                     | Page 29 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) |   | DATE<br>February 1997     |
|---|---|---------------------------|
| BUDGET ACTIVITY                                     | PE NUMBER AND TITLE   | PROJECT                   |
| <b>1 - Basic Research</b>                           | <b>0601102A Defense Research Sciences</b>   | <b>BH67</b>               |
| <b>FY 1997 Planned Program:</b>                     |   |                           |
| <b>(continued)</b>                                  |   |                           |
|   | <ul style="list-style-type: none"> <li>- Release final report on halon alternative compounds research and transition to commercial sector for potential non-military applications.</li> <li>- Identify an environmentally benign fluid that will eliminate volatile organic compounds (VOC) presently used to process pyrotechnic flares.</li> </ul>  |                           |
| • 1216  | <ul style="list-style-type: none"> <li>- Funds to be reprogrammed to Project BT25 of this program element to expand environmental research to provide the basic knowledge needed to develop physical, chemical, and biological technologies to clean up Army contaminated sites; to maintain compliance and prevent pollution at Army installations; to complete validations and scaling comparisons and transition to site assessment and restoration programs and to conduct landform and ecological modeling.</li> </ul>           |                           |
| • 110   | <ul style="list-style-type: none"> <li>- Small Business Innovative Research/Small Business Technology Transfer Programs.</li> </ul>   |                           |
| Total   | 4798  |                           |
| <b>FY 1998 Planned Program:</b>                     |   |                           |
| • 1995  | <ul style="list-style-type: none"> <li>- Develop optimized microbial consortia to biodegrade CW agents/products.</li> <li>- Identify supercritical fluid solvents for demilitarization/recycling of triple base propellant.</li> <li>- Develop corrosion-resistant coatings, and plasma-based decoating technologies.</li> </ul>  |                           |
| • 1410  | <ul style="list-style-type: none"> <li>- Complete fabrication and examination of specimens prepared with hollow, cylindrical, coating targets.</li> <li>- Continue bioceramics Langmuir-Blodgett studies, reverse micelle, or other suitable systems to mimic natural processes.</li> <li>- Conduct aqueous processing studies with elastomeric proteins for coatings.</li> </ul>   |                           |
| • 804   | <ul style="list-style-type: none"> <li>- Complete characterization of energetic products and spent catalysts.</li> <li>- Complete study of fundamental physical and chemical characteristics of propellants which influence the ballistic temperature coefficient during combustion.</li> </ul>   |                           |
| • 1500  | <ul style="list-style-type: none"> <li>- Investigate chemical conjugates and other intermediate byproducts during biological degradation of explosives in soil.</li> <li>- Investigate bio-geochemical fate of mixed organics and metals in seasonally frozen soils.</li> <li>- Identify key ecological processes/interactions related to military impacts on ecosystems.</li> <li>- Complete initial definition of the chemistry of photo degradation of nitroaromatic compounds under different experimental conditions.</li> </ul> |                           |
| Total   | 5709  |                           |
| <b>FY 1999 Planned Program:</b>                     |   |                           |
| • 1484  | <ul style="list-style-type: none"> <li>- Determine the major physico-chemical parameters controlling the fate of chemical warfare (CW) agents in soil.</li> <li>- Optimize treatment procedures for enhancement of in-situ bioremediation of CW agents/products.</li> <li>- Optimize techniques for supercritical fluid triple-base demilitarization/recycling and solvent-free energetic material analysis.</li> <li>- Identify techniques for accelerating formation of self-assembled monolayer protective coatings.</li> </ul>    |                           |
| • 1200  | <ul style="list-style-type: none"> <li>- Complete fabrication and examination of specimens prepared with wire-wrapped, solid, cylindrical, coating targets.</li> </ul>  |                           |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>BH67</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| <p align="center">- Identify/develop aqueous degreasing and other promising systems.</p> <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Modify bioceramics polymers to enhance properties and processing methods.</li> <li>• 1233 - Complete solubility and microscopic evaluation for supercritical fluid processing of pyrotechnic binders.</li> <li style="padding-left: 20px;">- Develop laboratory scale formulation for environmentally safe processing of energetic plasticizers.</li> <li>• 1000 - Complete description of major biological degradation pathways of major explosive types; e.g., contaminant and media.</li> <li style="padding-left: 20px;">- Combine low-temperature, bio-geochemical fate of mixed organics and metals with discontinuous permafrost models.</li> <li style="padding-left: 20px;">- Establish cause/effect relationship of military stressors and ecosystem responses.</li> <li style="padding-left: 20px;">- Define catalyst poisoning mechanisms in photo catalytic destruction nitroaromatics.</li> </ul> <p>Total 4917</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5474</td> <td style="text-align: center;">5707</td> <td style="text-align: center;">5855</td> <td style="text-align: center;">5009</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5627</td> <td style="text-align: center;">4798</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-1816</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">3811</td> <td style="text-align: center;">4798</td> <td style="text-align: center;">5709</td> <td style="text-align: center;">4917</td> </tr> </tbody> </table> <p align="center">Change Summary Explanation: FY1996: Funds reprogrammed (-1663) to higher priority requirements.<br/>FY 1997: Congressional reduction of basic research activities.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5474 | 5707 | 5855 | 5009 | Appropriated Value | 5627 | 4798 |  |  | Adjustments to Appropriated Value | -1816 |  |  |  | FY 1998 Pres Bud Request | 3811 | 4798 | 5709 | 4917 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 5474  | 5707                          | 5855           | 5009           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 5627  | 4798                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -1816   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 3811  | 4798                          | 5709           | 4917           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| Project BH67  | Page 31 of 66 Pages   | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                            |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | <b>PROJECT</b><br><b>AH68</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH68 Processes in Pollution Abatement Technology  | 419               | 343                 | 427                        | 447   | 465                 | 283                 | 291                       | 300                           | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides fundamental understanding of the physical, chemical and biological properties and mechanisms that control the degradation and treatment of hazardous wastes on military installations. This research is used to obtain basic technical information necessary for the design of treatment systems for both cleanup of existing hazardous waste sites and control of future hazardous waste generation. Wastes of concern include explosives, propellants, chemical agents and smokes. This project supports applied research efforts in program element 0602720A (Sensors and Electronic Survivability), Projects AF25 and DO48.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 419 - Initiated enzymatic studies of explosives degradation.</li> <li style="padding-left: 20px;">- Identified bacterial cultures in RDX/HMX (explosives) biodegradation.</li> </ul> <p>Total 419</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 335 - Complete enzymatic studies of explosives degradation.</li> <li style="padding-left: 20px;">- Isolate/identify microbial genera and define pathways in nitrocellulose (NC), nitroglycerine (NG), and dinitrotoluene (DNT) degradation.</li> <li>• 8 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 343</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 427 - Provide implementation guidance on microbial destruction of TNT in soils.</li> <li style="padding-left: 20px;">- Complete studies on explosives bioprocessing in flow through bioreactors.</li> </ul> <p>Total 427</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 447 - Continue determination of fundamental microbiological processes impacting the biodegradation of explosives and their byproducts.</li> <li style="padding-left: 20px;">- Complete minimal growth requirements for bacteria involved with destruction of energetic wastes.</li> </ul> <p>Total 447</p> |                   |                     |                            |   |                     |                     |                           |                               |                     |            |
| Project AH68  |                   |                     | <i>Page 32 of 66 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0601102A) |                               |                     |            |

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|  |   |                              |                               |                |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>                             |   | DATE<br><b>February 1997</b> |                               |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                              | <b>PROJECT</b><br><b>AH68</b> |                |
| <b>B. <u>Project Change Summary</u></b>  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u>                | <u>FY 1999</u> |
| FY 1997 President's Budget   | 389   | 408                          | 424                           | 438            |
| Appropriated Value   | 400   | 343                          |                               |                |
| Adjustments to Appropriated Value  | +19   |                              |                               |                |
| FY 1998 Pres Bud Request   | 419   | 343                          | 427                           | 447            |
| Change Summary Explanation: FY 1997: Congressional reduction of basic research activities. |   |                              |                               |                |
|  |   |                              |                               |                |
| Project AH68   | <i>Page 33 of 66 Pages</i>  |                              | Exhibit R-2 (PE 0601102A)     |                |

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|--|-------------------|---------------------|----------------------------|---|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                            |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | <b>PROJECT</b><br><b>BS04</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| BS04 Military Pollutants and Health Hazards  | 649               | 585                 | 718                        | 750   | 782                 | 516                 | 531                       | 546                           | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides basic research in innovative, less costly, and less time consuming toxicity assessment methods for determining potential human health and environmental effects of military-unique hazardous wastes and chemicals, including explosives, propellants, and smokes. These new testing techniques will help to prioritize hazardous waste and waste treatment technologies and screen new Army chemicals for potential toxic effects. The work is conducted at US Army Biomedical Research and Development Laboratory (USABRDL) and US Army Center for Health Promotion and Preventive Medicine (CHPPM).</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 649 - Explored improvements in specific environmental toxicity methods (USABRDL).             <ul style="list-style-type: none"> <li>- Identified sentinel biomonitoring systems (USABRDL).</li> <li>- Explored cross-species extrapolation of non-mammalian bioassay systems (USABRDL/CHPPM).</li> <li>- Identified methods for integrated environmental assessment of contaminated sites at Army installations (USABRDL).</li> </ul> </li> </ul> <p>Total 649</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 571 - Continue to explore improvements in specific environmental toxicity methods (USABRDL).             <ul style="list-style-type: none"> <li>- Identify additional sentinel biomonitoring systems (USABRDL).</li> <li>- Continue exploration of cross-species extrapolation of non-mammalian bioassay systems (USABRDL/CHPPM).</li> <li>- Refine identification of methods for integrated environmental assessment of contaminated sites at Army installations (USABRDL).</li> </ul> </li> <li>• 14 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 585</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 718 - Continue to explore improvements in specific environmental toxicity methods (USABRDL).             <ul style="list-style-type: none"> <li>- Identify additional sentinel biomonitoring systems (USABRDL).</li> <li>- Continue exploration of cross-species extrapolation of non-mammalian bioassay systems (USABRDL/CHPPM).</li> <li>- Refine identification of methods for integrated environmental assessment of contaminated sites at Army installations (USABRDL).</li> </ul> </li> </ul> <p>Total 718</p> |                   |                     |                            |   |                     |                     |                           |                               |                     |            |
| Project BS04   |                   |                     | <i>Page 34 of 66 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0601102A) |                               |                     |            |

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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-----|-----|-----|-----|--------------------|-----|-----|--|--|-----------------------------------|-----|--|--|--|--------------------------|-----|-----|-----|-----|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>BS04</b> |                |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 750 - Continue to explore improvements in specific environmental toxicity methods (USABRD).</li> <li style="padding-left: 20px;">- Identify additional sentinel biomonitoring systems (USABRD).</li> <li style="padding-left: 20px;">- Continue exploration of cross-species extrapolation of non-mammalian bioassay systems (USABRD/CHPPM).</li> <li style="padding-left: 20px;">- Refine identification of methods for integrated environmental assessment of contaminated sites at Army installations (USABRD).</li> </ul> <p>Total 750</p>  |   |                               |                |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">666</td> <td style="text-align: center;">696</td> <td style="text-align: center;">724</td> <td style="text-align: center;">748</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">685</td> <td style="text-align: center;">585</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-36</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">649</td> <td style="text-align: center;">585</td> <td style="text-align: center;">718</td> <td style="text-align: center;">750</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Congressional reduction of basic research activities.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 666 | 696 | 724 | 748 | Appropriated Value | 685 | 585 |  |  | Adjustments to Appropriated Value | -36 |  |  |  | FY 1998 Pres Bud Request | 649 | 585 | 718 | 750 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |
| FY 1997 President's Budget  | 666   | 696                           | 724            | 748            |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |
| Appropriated Value  | 685   | 585                           |                |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |
| Adjustments to Appropriated Value   | -36   |                               |                |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |
| FY 1998 Pres Bud Request  | 649   | 585                           | 718            | 750            |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |
| Project BS04  | <i>Page 35 of 66 Pages</i>  | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |  |  |  |                          |     |     |     |     |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | <b>PROJECT</b><br><b>BS13</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| BS13 Science Base/Medical Research Infectious Disease   | 8964              | 8253                | 10209               | 11357   | 11763               | 12169               | 12883                     | 13145                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 8964 - Determined that natural immunity occurs during re-infection with hepatitis E virus in non-human primates; established feasibility of a recombinant dengue vaccine in mice; characterized structure of certain key Hantaan macromolecules.</li> <li>- Initiated studies to identify key antigens of blood stage <i>Plasmodium vivax</i> capable of inducing protective immunity against relapsing malaria; explored selected antigens for incorporation in a skin test for the detection of leishmaniasis; established feasibility of a sensitive wicking assay for the identification of <i>P. falciparum</i> infected mosquitoes in forward areas.</li> <li>- Characterized the structure, function, and antigenicity of certain key ETEC macromolecules; established feasibility of using <i>in vitro</i> assays for evaluating drug resistance in scrub typhus isolates; characterized the structure of certain key <i>Campylobacter</i> macromolecules.</li> <li>- Established feasibility of a probe-based colorimetric polymerase chain reaction (PCR) assays for identification of hantaviruses, dengue viruses and sandfly fever viruses; established feasibility of a new dot blot assay for the detection of dengue infections; documented the introduction of dengue 2 virus into the Amazon region of Peru; continued identification of viruses isolated from mosquito pools during a Rift Valley Fever outbreak in 1993; established feasibility of using new methods for fermentation and purification of vaccine candidates for <i>shigella</i>, <i>Campylobacter</i>, malaria and dengue.</li> </ul> <p>Total 8964</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1938 - Characterize the immune response to <i>P. falciparum</i> , and identify protective antigens. Study correlates of immunity that can be predicted <i>in vitro</i>.</li> <li>• 1281 - Identify virulence factors of <i>Shigella</i>, <i>E. coli</i>, and <i>Campylobacter</i>. Characterize the immune response against these organisms.</li> <li>• 695 - Investigate parasite biology to support the antiparasitic drug effort. Conduct screening assays to support drug discovery, drug susceptibility, and resistance reversal.</li> <li>• 827 - Use genetic engineering to identify, isolate, clone, and produce selected antigens that are potential protective antigens in dengue fever. Investigate surrogate markers for long term immunity against dengue fever.</li> </ul> |                   |                     |                     |   |                     |                     |                           |                               |                     |            |
| Project BS13  |                   |                     | Page 36 of 66 Pages |   |                     |                     | Exhibit R-2 (PE 0601102A) |                               |                     |            |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |   | DATE<br>February 1997     |
|---|---|---------------------------|
| BUDGET ACTIVITY   | PE NUMBER AND TITLE                       | PROJECT                   |
| <b>1 - Basic Research</b>   | <b>0601102A Defense Research Sciences</b> | <b>BS13</b>               |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 960 - Investigate the mechanisms of resistance to antiparasitic drugs, and identify key antigens for the diagnosis of <i>Leishmania</i>. Investigate vector physiology as a source of novel vector control strategies.</li> <li>• 425 - Investigate ways in which outer membrane proteins of the meningitis organism can be preserved in native conformation. Develop fundamental information about the genes and proteins of rickettsial organisms.</li> <li>• 1161 - Pursue new methodologies to identify, cultivate, and characterize hemorrhagic fever and encephalitis viruses. Conduct epidemiology to determine the threat of hepatitis E in US Forces.</li> <li>• 765 - Select immunodominant antigens that are key to forward deployable diagnostic tests, and identify new candidate antigens and adjuvants to support improved vaccine production technology. Define the risk of emerging disease threats to US Forces.</li> <li>• 201 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 8253</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2035 - Characterize the immune response to <i>P. falciparum</i> and <i>P. vivax</i>, and clone protective antigens. Investigate the induction of immunologic memory against key malarial antigens.</li> <li>• 1355 - Identify the full range of protective antigens of <i>Shigella</i>, <i>E. coli</i>, and <i>Campylobacter</i>. Clone the antigens that are the most promising vaccine candidates.</li> <li>• 957 - Clone and express novel parasitic antigens as targets for rational structure-based drug design. Analyze the antiparasitic activity of naturally occurring chemical compounds.</li> <li>• 872 - Use genetic engineering to prepare selected DNA sequences that are potential candidates for inclusion into a DNA vaccine against dengue fever.</li> <li>• 1013 - Investigate possible mechanisms to assess total parasite burden in infected personnel, and evaluate <i>in vitro</i> technologies for the diagnosis of leishmaniasis using serum antibody. Establish feasibility of controlling vectors by altering vector physiology.</li> <li>• 394 - Investigate antigenic variation and phase variation in the organism that causes meningitis. Identify key antigens in the immune response to rickettsial organisms.</li> <li>• 1116 - Clone and sequence genes of interest in hemorrhagic fever and encephalitis viruses. Express candidate vaccine and diagnostic antigens for hepatitis E virus.</li> <li>• 967 - Clone genes of key diagnostic antigens of interest to develop forward deployed diagnostics, and investigate technologies to deliver antigens and adjuvants to the immune system. Improve procedures for the collection and transport of clinical specimens under less than ideal conditions.</li> <li>• 1500 - Begin characterization of malaria genome.</li> </ul> <p>Total 10209</p> |   |                           |
| Project BS13  | Page 37 of 66 Pages                       | Exhibit R-2 (PE 0601102A) |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|-------|-------|--------------------|------|------|--|--|-----------------------------------|------|---|--|--|--------------------------|------|------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>BS13</b> |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2200 - Characterize the immune response to <i>P. falciparum</i> and <i>P. vivax</i>, clone protective antigens, and identify gene sequences that should be included in a DNA vaccine from data obtained from sequencing the entire malaria genome.</li> <li>• 1430 - Identify key epitopes within the protective antigens of <i>Shigella</i>, <i>E. coli</i>, and <i>Campylobacter</i>. Investigate the adjuvant effect and other mechanisms to enhance mucosal immunity.</li> <li>• 1150 - Perform structure activity chemical searches. Design new screening models to support drug discovery using fingerprinting to determine structure-activity relationships and from data obtained from sequencing the entire malaria genome.</li> <li>• 1011 - Investigate possible surrogate markers for long term immunity to dengue fever.</li> <li>• 1161 - Identify conserved parasite antigens that can serve as targets for diagnostic probes to detect drug resistant parasites, and investigate methods to increase the yields of <i>Leishmania</i> amastigotes to support studies.</li> <li>• 416 - Investigate molecular mimicry in the organism that causes meningitis. Investigate antigenic diversity in rickettsial organisms.</li> <li>• 1183 - Express candidate vaccine and diagnostic antigens for hemorrhagic fever and encephalitis viruses. Investigate antigenic diversity in hepatitis E virus.</li> <li>• 1306 - Express candidate diagnostic antigens for forward deployed diagnostic tests, and investigate ways to preserve antigens during production. Provide training to host country physicians and scientists to enhance their role in the identification and reporting of new disease events.</li> <li>• 1500 - Continue characterization of malaria genome.</li> </ul> <p>Total 11357</p> |   |                               |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9282</td> <td style="text-align: center;">9815</td> <td style="text-align: center;">10004</td> <td style="text-align: center;">10244</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">9543</td> <td style="text-align: center;">8253</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-579</td> <td style="text-align: center;">0</td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">8964</td> <td style="text-align: center;">8253</td> <td style="text-align: center;">10209</td> <td style="text-align: center;">11357</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Congressional reduction of basic research activities.<br/>FY 1999- Increase reflects decision to provide more emphasis to basic research in this area.</p>  |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9282 | 9815 | 10004 | 10244 | Appropriated Value | 9543 | 8253 |  |  | Adjustments to Appropriated Value | -579 | 0 |  |  | FY 1998 Pres Bud Request | 8964 | 8253 | 10209 | 11357 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
| FY 1997 President's Budget   | 9282  | 9815                          | 10004          | 10244          |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
| Appropriated Value   | 9543  | 8253                          |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
| Adjustments to Appropriated Value  | -579  | 0                             |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
| FY 1998 Pres Bud Request   | 8964  | 8253                          | 10209          | 11357          |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |
| <p>Project BS13 <span style="float: right;">Page 38 of 66 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0601102A)</span></p>  |   |                               |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |       |       |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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|   |   |                               |
|---|---|-------------------------------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>BS14</b> |
|---|---|-------------------------------|

| COST <i>(In Thousands)</i>                      | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|---|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| BS14 Science Base/Combat Casualty Care Research | 4071              | 3749                | 4523                | 4702                | 4925                | 5118                | 5224                | 5346                | Continuing          | Continuing |

**A. Mission Description and Justification:** This project conducts 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 “brass 10 minutes” and achieve a “golden hour” following trauma injury, minimize lost duty time from minor battle and non-battle injuries, and provide military medical capabilities for far-forward medical/surgical care of battle and non-battle injuries.

**FY 1996 Accomplishments:**

- 2004 - Characterized physiological effects of hemoglobin in animal models.  
- Developed models for evaluation of fibrin-based hemostatic bandages to control hemorrhage.  
- Continued microbiological surveillance of burn victims and explored role of endocrine and other mediators in burn wound infection and hypermetabolism.
  - 2067 - Completed development of spinal cord injury model; continued to characterize effects of lead candidate neuroprotective compounds; evaluated protective effects of heat shock protein over expression.  
- Identified critical physiological markers following hemorrhage and trauma for non-invasive sensor development; expanded inventory of potential "smart fiber" sensor materials to offer greater choices for minimally invasive measurements.  
- Evaluated potential countermeasures to ameliorate smoke inhalation injury and improve outcome in a small animal injury model.
- Total            4071

**FY 1997 Planned Program:**

- 3658 - Explore feasibility of fibrin adhesives and foams for use in combat wounds. Begin identifying resuscitative technologies to ameliorate central and peripheral neural injury.  
- Identify basic mechanisms of central nervous system damage occurring secondarily to trauma; explore basic mechanisms of organ failure in shock.  
- Explore role of endocrine and other mediators in burn wound infection and hypermetabolism; continue microbiological surveillance of burn victims.  
- Conduct animal testing of miniature, fiber optic, catheter-based blood gas monitor for base deficit determination.  
- Conduct additional evaluations of potential countermeasures for smoke inhalation injury in small and large animal injury models; evaluate countermeasures for musculoskeletal injury.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|---|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>BS14</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| <p align="center">- Explore feasibility of cartilage repair for high stress joint injuries and combat caused joint injuries.</p> <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Identify additional candidate technologies as non-invasive sensors, sensor fusion mechanisms or chip-based, local data-processing systems, to improve diagnostics and treatment decisions far forward.</li> <li>• 91 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3749</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4523 - Demonstrate feasibility of "Smart Tourniquet."</li> <li>- Demonstrate feasibility of microwave warming catheter.</li> <li>- Test feasibility of medical decision assist algorithm.</li> <li>- Investigate feasibility of hemostatic spray for external and internal hemorrhages.</li> <li>- Investigate feasibility of "Lexin" as a candidate drug for prevention of ischemia/reperfusion injury in brain and spinal cord.</li> <li>- Explore feasibility of novel technologies or concepts to support research on dental trauma or maxillofacial injury.</li> </ul> <p>Total 4523</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4702 - Determine feasibility of high speed data acquisition and parallel processing in handling real-time acquired physiological data in a hand held or body worn computer.</li> <li>- Evaluate ability of medical decision assist algorithms to predictably triage and assist in deciding initial diagnoses.</li> <li>- Test feasibility of locally-applied oxygen to heal burn or other soft-tissue trauma wounds.</li> <li>- Investigate feasibility of various phospholipase A2 inhibitors and serine protease inhibitors for prevention of ischemia/reperfusion injury in brain, spinal cord, and other organs.</li> <li>- Determine feasibility of using text search engines as an enabling technology in medical translation.</li> </ul> <p>Total 4702</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4217</td> <td style="text-align: center;">4459</td> <td style="text-align: center;">4546</td> <td style="text-align: center;">4656</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4336</td> <td style="text-align: center;">3749</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-265</td> <td style="text-align: center;">0</td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4071</td> <td style="text-align: center;">3749</td> <td style="text-align: center;">4523</td> <td style="text-align: center;">4702</td> </tr> </tbody> </table> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4217 | 4459 | 4546 | 4656 | Appropriated Value | 4336 | 3749 |  |  | Adjustments to Appropriated Value | -265 | 0 |  |  | FY 1998 Pres Bud Request | 4071 | 3749 | 4523 | 4702 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 4217  | 4459                          | 4546           | 4656           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| Appropriated Value   | 4336  | 3749                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -265  | 0                             |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 4071  | 3749                          | 4523           | 4702           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| Project BS14   |   | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |

DATE  
**February 1997**

BUDGET ACTIVITY  
**1 - Basic Research**

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

Change Summary Explanation: Funding: FY 1997- Congressional reduction of basic research activities.

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |   |                |                  |  |                  |                  |                  | DATE<br>February 1997     |                        |                  |            |
|--|---|----------------|------------------|--|------------------|------------------|------------------|---------------------------|------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |   |                |                  | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                  |                  |                  |                           | PROJECT<br><b>BS15</b> |                  |            |
| COST (In Thousands)  |   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate       | Cost to Complete | Total Cost |
| BS15   | Science Base/Army Operational Medicine Research | 6654           | 5543             | 6094   | 6863             | 7139             | 7418             | 7574                      | 7752                   | Continuing       | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 6654 - Identified candidate compounds to enhance the restorative values of short duration sleep periods.</li> <li>- Characterized gender-related differences in susceptibility to heat-induced injuries.</li> <li>- Characterized the time-course of ocular injury from ultra short-pulse laser pulses.</li> <li>- Determined role of antioxidants in prevention of tissue damage from blast over pressure and toxic gas exposure.</li> <li>- Identified the cellular consequences of hyperthermia useful for heat stress prevention.</li> </ul> <p>Total 6654</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5407 - Characterize effects of antioxidant nutrients for preventing stress-induced suppression of immune function.</li> <li>- Identify nutritional and pharmacological strategies to reduce incidence and severity of cold-induced injuries.</li> <li>- Characterize the time course of injury from high-peak power, short-pulse duration microwave radiation.</li> <li>- Define the role of environmental chemical exposure and reactive oxygen activity on immunotoxicity.</li> <li>• 136 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5543</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6094 - Test stress diagnostics for telemedicine use in forward identification of soldiers at risk for combat stress.</li> <li>- Identify nutritional and pharmacological strategies to reduce incidence and severity of altitude-related injuries.</li> </ul> |   |                |                  |  |                  |                  |                  |                           |                        |                  |            |
| Project BS15   |   |                |                  | Page 41 of 66 Pages  |                  |                  |                  | Exhibit R-2 (PE 0601102A) |                        |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|---|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
|  |   | <b>PROJECT</b><br><b>BS15</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Develop biomarkers of exposure to xenobiotic chemicals.</li> <li>- Map laser retinal lesions to assess chronic effects of accidental off-axis exposure to current rangefinders/designators.</li> </ul> <p>Total            6094</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            6863 - Develop <i>in vivo</i> photoreceptor imaging in primate models to enhance assessment of laser retinal injury and repair mechanisms.</li> <li>             - Evaluate candidate ergogenic aids suitable for ration supplementation to facilitate cognitive and psychomotor performance in Special Operations Forces (SOF) soldiers.</li> <li>             - Evaluate a multiple integrated sensor suite through a wireless body local area network (LAN) system to support telemedicine assessment of combat stress.</li> </ul> <p>Total            6863</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">6884</td> <td style="text-align: center;">6591</td> <td style="text-align: center;">6931</td> <td style="text-align: center;">7098</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">7078</td> <td style="text-align: center;">5543</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-424</td> <td style="text-align: center;">0</td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">6654</td> <td style="text-align: center;">5543</td> <td style="text-align: center;">6094</td> <td style="text-align: center;">6863</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding- FY 1997- Congressional reduction to basic research activities.<br/> FY 1998- Funds reprogrammed (-837) to higher priority requirements.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 6884 | 6591 | 6931 | 7098 | Appropriated Value | 7078 | 5543 |  |  | Adjustments to Appropriated Value | -424 | 0 |  |  | FY 1998 Pres Bud Request | 6654 | 5543 | 6094 | 6863 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 6884  | 6591                          | 6931           | 7098           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| Appropriated Value   | 7078  | 5543                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -424  | 0                             |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 6654  | 5543                          | 6094           | 6863           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |
| Project BS15   | Page 42 of 66 Pages   | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |   |  |  |                          |      |      |      |      |

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| RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)  |                |                  |                     |  |                  |                  |                           | DATE<br>February 1997 |                        |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
|---|----------------|------------------|---------------------|--|------------------|------------------|---------------------------|-----------------------|------------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|-----|-----|-----|-----|--------------------|-----|-----|--|--|-----------------------------------|-----|---|--|--|--------------------------|-----|-----|---|---|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                |                  |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                  |                  |                           |                       | PROJECT<br><b>BS16</b> |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate    | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate      | Cost to Complete       | Total Cost |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| BS16 Science Base/Combat Dentistry Research   | 464            | 459              | 0                   | 0  | 0                | 0                | 0                         | 0                     | 0                      | 923        |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 464 - Conducted strength testing of candidate materials, and fabricated and conducted mechanical testing of biodegradable bone screws.</li> <li style="padding-left: 20px;">- Explored conventional and exotic fabrication techniques to replicate synthetic bone repair.</li> </ul> <p>Total 464</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 447 - Evaluate efficacy and safety of biodegradable bone screws in animal injury models.</li> <li style="padding-left: 20px;">- Develop capability to fabricate bone replicas from 3-D in-house obtained data using CAD/CAM algorithms and in-house machine tools.</li> <li>• 12 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 459</p> <p><b>FY 1998 Planned Program:</b> Project tasks and funding restructured to PE 0601102A Project BS14.</p> <p><b>FY 1999 Planned Program:</b> Project tasks and funding restructured to PE 0601102A, Project BS14.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table border="0" style="width: 100%;"> <thead> <tr> <th></th> <th align="right"><u>FY 1996</u></th> <th align="right"><u>FY 1997</u></th> <th align="right"><u>FY 1998</u></th> <th align="right"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">482</td> <td align="right">545</td> <td align="right">558</td> <td align="right">572</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">496</td> <td align="right">459</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-32</td> <td align="right">0</td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">464</td> <td align="right">459</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding change in FY 1998 and 1999 reflects movement of project tasks and funding to Project BS14.</p> |                |                  |                     |  |                  |                  |                           |                       |                        |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 482 | 545 | 558 | 572 | Appropriated Value | 496 | 459 |  |  | Adjustments to Appropriated Value | -32 | 0 |  |  | FY 1998 Pres Bud Request | 464 | 459 | 0 | 0 |
|   | <u>FY 1996</u> | <u>FY 1997</u>   | <u>FY 1998</u>      | <u>FY 1999</u>   |                  |                  |                           |                       |                        |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| FY 1997 President's Budget  | 482            | 545              | 558                 | 572  |                  |                  |                           |                       |                        |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| Appropriated Value  | 496            | 459              |                     |  |                  |                  |                           |                       |                        |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| Adjustments to Appropriated Value   | -32            | 0                |                     |  |                  |                  |                           |                       |                        |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| FY 1998 Pres Bud Request  | 464            | 459              | 0                   | 0  |                  |                  |                           |                       |                        |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |
| Project BS16  |                |                  | Page 43 of 66 Pages |  |                  |                  | Exhibit R-3 (PE 0601102A) |                       |                        |            |  |                |                |                |                |                            |     |     |     |     |                    |     |     |  |  |                                   |     |   |  |  |                          |     |     |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                            |   |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                           |                     | <b>PROJECT</b><br><b>BS17</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| BS17 Molecular Biology/Military HIV Research   | 877               | 783                 | 499                        | 482   | 552                 | 592                       | 612                 | 635                           | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 858 - Identified key genomic differences among various clades (strains) of HIV-1 that are important considerations for vaccine development. <ul style="list-style-type: none"> <li>- Demonstrated trans-global migration of diverse HIV genotypes via infection of U.S. military and U.N. peacekeeping forces deployed abroad.</li> <li>- Demonstrated rising incidence of AZT-resistant virus in seroconverting HIV-infected persons.</li> </ul> </li> <li>• 19 - Identified key genomic differences among various clades (strains) of HIV-1 that are important considerations for vaccine development.</li> </ul> <p>Total 877</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 764 - Evaluate preclinically oligomeric proteins as vaccine candidates based upon information obtained from worldwide variability of the HIV genome. <ul style="list-style-type: none"> <li>- Study transmission kinetics of newly-introduced HIV types.</li> <li>- Determine potential for an alphavirus-vectored HIV DNA recombinant vaccine construct.</li> </ul> </li> <li>• 19 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 783</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 499 - Evaluate HIV sub-unit peptides as vaccine candidates to combat worldwide HIV strains. <ul style="list-style-type: none"> <li>- Develop methods to evaluate international threat assessment of HIV strains.</li> <li>- Complete study of transmission kinetics of newly introduced HIV recombinant strains.</li> </ul> </li> </ul> <p>Total 499</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 482 - Develop methods to evaluate the international threat of various HIV strains.</li> </ul> |                   |                     |                            |   |                     |                           |                     |                               |                     |            |
| Project BS17   |                   |                     | <i>Page 44 of 66 Pages</i> |   |                     | Exhibit R-2 (PE 0601102A) |                     |                               |                     |            |

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|---|---|------------------------------|-------------------------------|----------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |                               |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                              | <b>PROJECT</b><br><b>BS17</b> |                |
| Total   | 482   |                              |                               |                |
| <b><u>B. Project Change Summary</u></b>   | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u>                | <u>FY 1999</u> |
| FY 1997 President's Budget  | 908   | 932                          | 999                           | 1024           |
| Appropriated Value  | 933   | 783                          |                               |                |
| Adjustments to Appropriated Value   | -56   | 0                            |                               |                |
| FY 1998 Pres Bud Request  | 877   | 783                          | 499                           | 482            |
| <p>Change Summary Explanation: Funding: FY 1997 - Congressional reduction to basic research activities.<br/>                 FY 1998/FY 1999 - Funds reprogrammed (FY 1998, -500; FY 1999, -542) to higher priority requirements.</p> |   |                              |                               |                |
|   |   |                              |                               |                |
| Project BS17  | Page 45 of 66 Pages   | Exhibit R-2 (PE 0601102A)    |                               |                |



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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|-----|--|--|-----------------------------------|--|--|--|--|--------------------------|---|-----|---|---|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>BS18</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| BS18 Marine Derived Biocatalysts   | 0                 | 636                 | 0                   | 0  | 0                   | 0                   | 0                         | 0                            | 0                   | 636        |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> Biocatalysts (enzymes) which degrade organophosphorus chemical agents and other hazardous defense industry-related materials will be isolated from marine microorganisms. Gene codings for the production of these biocatalysts will be cloned and expressed in suitable bacterial or insect cell systems and produced by fermentation in large scale (i.e. gram). Both genetic and bioreactor variables will be optimized for efficient biomanufacture of active, stable, hazardous material degrading enzymes.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 620 - Isolate and purify Organophorus Acid Anhydrolase and other hydrolytic or oxidoreductase enzyme candidates and test activity.               <ul style="list-style-type: none"> <li>- Clone genes and express in suitable vector.</li> <li>- Scale up fermentation and produce gram quantities.</li> </ul> </li> <li>• 16 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 636</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">636</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">636</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: FY 97 funding reflects Congressional add for this special interest item.</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 636 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 636 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| FY 1997 President's Budget   | 0                 | 0                   | 0                   | 0  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Appropriated Value   | 0                 | 636                 |                     |  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Adjustments to Appropriated Value  |                   |                     |                     |  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| FY 1998 Pres Bud Request   | 0                 | 636                 | 0                   | 0  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Project BS18   |                   |                     | Page 46 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |

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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>AT22</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AT22 Soil and Rock Mechanics  | 1897              | 1730                | 2095                | 2180   | 2281                | 2369                | 2416                      | 2470                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 applied research to provide: analytical capabilities for mobility assessments; hardened battlefield positions, fixed facilities, and semi-fixed assets; multispectral camouflage, concealment, and deception for fixed facilities; and advanced vertical and horizontal construction materials in PE 0602784A (Military Engineering Technology), Project AT40.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1897 - Developed pavement fracture and durability mechanics models for application in predicting pavement performance.</li> <li>- Quantified performance parameters of advanced high-strength structural materials for anti-penetration shields/hardened structures.</li> <li>- Validated soil/climatological relationships for soil-moisture strength prediction in humid microthermal, undifferentiated highland, and humid esothermal climates.</li> <li>- Provided quantitative recommendations for designing/selecting a sensor suite for in-situ discrimination applications.</li> <li>- Performed quantitative evaluations and matching of selected responsive/passive materials to backgrounds.</li> </ul> <p>Total 1897</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1688 - Develop first-principle computer code to calculate long-rod penetrator performance during normal impact against concrete targets.</li> <li>- Document soil/climatological relationships for predicting/evaluating soil-moisture strength world wide.</li> <li>- Develop substrate specifications for materials to host responsive/passive concealment and camouflage deception (CCD) laminate materials.</li> <li>- Develop dynamic constitutive models for pavement materials and continue formulation of traffic distribution model.</li> <li>• 42 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1730</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project AT22  |                   |                     | Page 47 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|--|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> | PROJECT<br><b>AT22</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2095 - Conduct subscale tests and calculational analyses of hard-target penetrators against advanced concretes.</li> <li style="padding-left: 20px;">- Determine appropriate combinations of responsive/passive composite materials as a function of environment and facility type.</li> <li style="padding-left: 20px;">- Validate models for predicting the durability and dynamic behavior of pavement materials.</li> <li style="padding-left: 20px;">- Develop field measuring devices to collect loading patterns of soil response to tracked vehicles.</li> </ul> <p>Total 2095</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2180 - Complete first-principle code calculations simulating oblique-impact long-rod penetration tests against concrete targets.</li> <li style="padding-left: 20px;">- Incorporate selected responsive/passive materials into/onto substrate host.</li> <li style="padding-left: 20px;">- Complete analytical models for predicting traffic distribution, cohesive soil moisture response, and compaction behavior.</li> <li style="padding-left: 20px;">- Conduct full-scale soil loading experiments for representative sample of tracked vehicles</li> </ul> <p>Total 2180</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1946</td> <td style="text-align: center;">2057</td> <td style="text-align: center;">2139</td> <td style="text-align: center;">2210</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2000</td> <td style="text-align: center;">1730</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-103</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1897</td> <td style="text-align: center;">1730</td> <td style="text-align: center;">2095</td> <td style="text-align: center;">2180</td> </tr> </tbody> </table> <p style="margin-left: 40px;">Change Summary Explanation: Funding: FY 1997- Congressional reduction to basic research activities.</p> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1946 | 2057 | 2139 | 2210 | Appropriated Value | 2000 | 1730 |  |  | Adjustments to Appropriated Value | -103 |  |  |  | FY 1998 Pres Bud Request | 1897 | 1730 | 2095 | 2180 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 1946   | 2057                         | 2139           | 2210           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 2000   | 1730                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -103   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 1897   | 1730                         | 2095           | 2180           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AT22   | Page 48 of 66 Pages  | Exhibit R-2 (PE 0601102A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>AT23</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AT23 Basic Research/Military Construction   | 1788              | 1500                | 1818                | 1892   | 1979                | 2054                | 2095                      | 2143                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project supports development of fundamental knowledge essential to develop the leap ahead technologies required to solve Army and Defense (via Project Reliance) unique problems in the planning, programming, design, construction, and sustainment of force projection platforms and energy and utility infrastructure to achieve the infrastructure cost reduction goals of the current national military strategy. This project supports exploratory development efforts in Program Element 0602784A ( Military Engineering Technology), Projects AT41 and AT45. This project also supports related Defense Modeling and Simulation Office-funded applications, and has significant dual-use application potential.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1788 - Incorporated abstract models that relate graphical display to mental models of users from different engineering disciplines.</li> <li style="padding-left: 20px;">- Developed capability to integrate collaborative software systems.</li> <li style="padding-left: 20px;">- Developed algorithms to predict post-elastic structural response of single degree of freedom systems under tri-axial loading.</li> </ul> <p>Total 1788</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1463 - Investigate models for self-responding composites for infrastructure applications.</li> <li style="padding-left: 20px;">- Develop models to predict the behavior of materials under load histories simulating earthquakes.</li> <li>• 37 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1500</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1818 - Develop engineer interaction protocols, common facility component representations, and facility knowledge-sharing algorithms to enable the development of an open collaborative engineering designer system.</li> <li style="padding-left: 20px;">- Develop an understanding of active magnetostrictive tagging of construction materials for monitoring structural health.</li> <li style="padding-left: 20px;">- Develop understanding of full 3-D behavior of steel building systems via testing on tri-axial shock test facility.</li> </ul> <p>Total 1818</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project AT23  |                   |                     | Page 49 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|----|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AT23</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1892 - Develop collaborative engineering methodologies to enable asynchronous design and engineering of facilities.</li> <li style="padding-left: 20px;">- Characterize electrical time domain reflectometry for evaluation of structural health of large concrete structures.</li> <li style="padding-left: 20px;">- Continue 3-D response analysis of steel buildings.</li> </ul> <p>Total 1892</p>  |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1737</td> <td style="text-align: center;">1784</td> <td style="text-align: center;">1844</td> <td style="text-align: center;">1889</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1785</td> <td style="text-align: center;">1500</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated value</td> <td style="text-align: center;">+3</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1788</td> <td style="text-align: center;">1500</td> <td style="text-align: center;">1818</td> <td style="text-align: center;">1892</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Congressional reduction to basic research activities.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1737 | 1784 | 1844 | 1889 | Appropriated Value | 1785 | 1500 |  |  | Adjustments to Appropriated value | +3 |  |  |  | FY 1998 Pres Bud Request | 1788 | 1500 | 1818 | 1892 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 1737  | 1784                          | 1844           | 1889           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 1785  | 1500                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated value  | +3  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 1788  | 1500                          | 1818           | 1892           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |
| Project AT23   | <i>Page 50 of 66 Pages</i>  | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |    |  |  |  |                          |      |      |      |      |

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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|------------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           |                              | PROJECT<br><b>AT24</b> |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| AT24 Snow, Ice and frozen Soil   | 1210              | 1104                | 1343                | 1399   | 1462                | 1517                | 1547                      | 1581                         | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project is the only focused DoD basic research program investigating the physical, chemical, and electrical properties of snow, ice, and frozen soil and characterization of dominant winter and cold regions processes impacting military materiel, operations, and facilities. It provides the knowledge base for exploratory development to support modeling and simulation and product improvements as well as leading to reduced life-cycle costs and increased readiness and operability in extreme cold, high altitude and seasonal winter conditions around the world. Products are directly input to PE 0602784A (Military Engineering Technology), 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1210 - Developed concept for integrated millimeter wave (MMW)/infrared (IR) signature modeling for snow-covered terrain.</li> <li style="padding-left: 20px;">- Modeled freezing effects on soil chemistry and behavior.</li> <li style="padding-left: 20px;">- Defined effects of electrical charging on snow friction and evaluated snow as a chemical absorption agent.</li> </ul> <p>Total 1210</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1077 - Develop first principles radar scattering model for ice.</li> <li style="padding-left: 20px;">- Develop 2- and 3-D models for freeze/thaw process for saturated soils.</li> <li style="padding-left: 20px;">- Develop analysis of atmospheric icing persistence; develop a dynamic model of ice inclusion size distribution.</li> <li>• 27 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1104</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1343 - Quantify the rapid and dynamic evolution of millimeter wave radar response in temperate snow conditions.</li> <li style="padding-left: 20px;">- Parameterize role of snow cover in turbulent exchange of heat and moisture in boundary layer.</li> <li style="padding-left: 20px;">- Quantify dominant acoustic propagation processes for mapping snow-covered terrain.</li> </ul> <p>Total 1343</p> |                   |                     |                     |  |                     |                     |                           |                              |                        |            |
| Project AT24   |                   |                     | Page 51 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                        |            |

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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>AT24</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1399 - Develop vectorized wave propagation code for viscoelastic/porous media.</li> <li style="padding-left: 20px;">- Define lab to geophysical scale effects on mechanical behavior of ice.</li> <li style="padding-left: 20px;">- Explore fundamental relationships between physical and electrical properties of ice.</li> </ul> <p>Total 1399</p>   |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
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|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 1241  | 1313                          | 1337           | 1369           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 1276  | 1104                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -66   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 1210  | 1104                          | 1343           | 1399           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Project AT24  | <i>Page 52 of 66 Pages</i>  | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |

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|--|---|-------------------|---------------------|--|---------------------|---------------------|---------------------|------------------------------|------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |   |                   |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                     |                              | PROJECT<br><b>BT25</b> |                     |            |
| COST <i>(In Thousands)</i>   |   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate  | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate          | FY 2003<br>Estimate    | Cost to<br>Complete | Total Cost |
| BT25   | Environmental Research - Corps of Engineers | 4725              | 3070                | 3608   | 4001                | 3749                | 3757                | 3091                         | 3214                   | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 and preventing pollution at non-industrial installations. The focus in conservation is on landform and ecological modeling, the feasibility of development and propagation of resilient plant species for rehabilitation of damaged lands, and fundamentals of training and test activity noise as they might be applied to reducing adverse effects on mission activities. This project will also examine the underlying requirements for comprehensive environmental modeling and simulation products to address environmental issues. The project supports exploratory development efforts in PE 062720A (Environmental Quality Technology), Projects AF25, D048, and A896. 65% of the funds in this project are used to support extramural research via a Broad Area Announcement requesting work supporting in-house laboratory efforts.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4725 - Developed species risk and richness models.</li> <li style="padding-left: 20px;">- Developed fundamental understanding of impulse sound propagation.</li> <li style="padding-left: 20px;">- Investigated fundamental mechanisms of spectral response for contaminant identification and quantification.</li> <li style="padding-left: 20px;">- Investigated solute exclusion and contaminant transport for frozen, snow-covered and ice-covered regimes and wetlands.</li> <li style="padding-left: 20px;">- Initiated research to understand the role of biodiversity in ecosystem integrity.</li> <li style="padding-left: 20px;">- Continued development of geomorphological process modeling for archeological site and soil erosion predictions.</li> </ul> <p>Total 4725</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2995 - Evaluate remote monitoring technologies for threatened and endangered species responses to Army training.</li> <li style="padding-left: 20px;">- Develop erosion control techniques using cryptogamic soil crusts.</li> <li style="padding-left: 20px;">- Identify fundamentals of spatial data visualization and registration.</li> <li style="padding-left: 20px;">- Investigate fundamental science of biosensor technology for application to cleanup site characterization.</li> <li style="padding-left: 20px;">- Evaluate soil, snow, ice, and contaminant parameters necessary to provide data fusion to describe contaminant transport processes in cold regions.</li> <li style="padding-left: 20px;">- Determine transportation mechanisms in heterogeneous multiphase soil systems.</li> <li>• 75 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> |   |                   |                     |  |                     |                     |                     |                              |                        |                     |            |
| Project BT25   |   |                   |                     | Page 53 of 66 Pages  |                     |                     |                     | Exhibit R-2 (PE 0601102A)    |                        |                     |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>BT25</b>   |                |                |
| Total  | 3070  |   |                |                |
| <b>FY 1998 Planned Program:</b>  |   |   |                |                |
| •  | 3608  | - Explore innovative site characterization sensor technologies and fundamental effects of complex media/contaminant interactions on sensor responses.<br>- Continue mathematical formulations for multi-contaminant groundwater transport mechanisms and analyze characteristics in heterogeneous media.<br>- Investigate bio-geochemical processes at low/freezing temperatures with quantified rates of activity and suppression/stimulation.<br>- Continue investigation of chemical conjugates and other intermediate byproducts during biological degradation of explosives in soil.<br>- Identify reaction mechanism and pathway for electrochemical reduction of energetic compounds in water.<br>- Develop an integrated hillslope and channel evolution model as an investigation and prediction tool. |                |                |
| Total  | 3608  |   |                |                |
| <b>FY 1999 Planned Program:</b>  |   |   |                |                |
| •  | 4001  | - Explore fundamentals of physical/chemical response of unexploded ordnance on candidate detection sensors.<br>- Improve theory, scaling, and computational tools for simulating fate and transport of contaminants in groundwater.<br>- Explore fundamentals of organic compound fate in freeze-thaw environments and combined biological/geochemical/geophysical measurement and detection.<br>- Complete description of major biological degradation pathways of major explosives types; e.g., contaminant and media.<br>- Develop kinetic and mechanistic understanding of sonochemical destruction of nitro-containing compounds.<br>- Determine plant varieties with improved resilience to military traffic and suitable for revegetation of training lands.   |                |                |
| Total  | 4001  |   |                |                |
| <b>B. Project Change Summary</b>   |   |   |                |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>  | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 3480  | 3652  | 3696           | 4073           |
| Appropriated Value   | 3579  | 3070  |                |                |
| Adjustments to Appropriated Value  | +1145   |   |                |                |
| FY 1998 Pres Bud Request   | 4725  | 3070  | 3608           | 4001           |
| Change Summary Explanation: Funding: FY1996- Funding increased (+\$1145K) to investigate solute exclusion and contaminant transport for frozen, snow-covered and ice-covered regimes and wetlands and to understand the role of biodiversity in ecosystem integrity. |   |   |                |                |
| FY 1997- Congressional reduction to basic research activities.   |   |   |                |                |
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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>A305</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A305 Automatic Target Recognition Research   | 1034              | 1132                | 1186                | 1237   | 1292                | 1340                | 1368                      | 1409                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1034 -Extended 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.</li> <li>-Investigated recent advances in the sciences of combinatorial optimization and computational geometry to approach near optimal search solutions for ATR algorithms.</li> <li>-Developed modeling techniques which allow the extension of multi-spectral scene generation (MSSG) to synthetic environment applications.</li> </ul> <p>Total 1034</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1124 -Develop hierarchical syntax/grammar for hybrid neural model-based ATR algorithms to include higher level model structures.</li> <li>-Apply learning theory to the ATR problem in order to automate the feature selection process.</li> <li>-Develop techniques for extension of MSSG to real-time virtual reality environment.</li> <li>8 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1132</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1186 -Provide single frame synthetic aperture radar/forward looking infrared/television (SAR/FLIR/TV) compression algorithm for tactical reconnaissance, surveillance, and target acquisition (RSTA) and munitions communication links.</li> <li>-Extend FLIR ATR algorithm performance to include limited on-the-fly training.</li> <li>-Extend existing two-sensor (FLIR/Laser Radar (LADAR) or FLIR/Millimeter Wave (MMW)) fusion ATR algorithms to other dual sensor combinations (i.e., FLIR/Visible, Visible/LADAR, Visible/MMW, etc.)</li> </ul> <p>Total 1186</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project A305   |                   |                     | Page 55 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>A305</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•           1237   -Provide real-time multi-frame electro-optic (EO) detection and compression algorithms for FLIR for use on existing battlefield communication links.</li> <li>                          -Enhance 2nd generation FLIR ATR capabilities to handle targets at 4km ranges.</li> <li>                          -Extend FLIR/MMW/LADAR ATR algorithms to operate in up to 40% occlusion.</li> </ul> <p>Total           1237</p>   |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1045</td> <td style="text-align: center;">1156</td> <td style="text-align: center;">1182</td> <td style="text-align: center;">1214</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1073</td> <td style="text-align: center;">1132</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-39</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1034</td> <td style="text-align: center;">1132</td> <td style="text-align: center;">1186</td> <td style="text-align: center;">1237</td> </tr> </tbody> </table> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1045 | 1156 | 1182 | 1214 | Appropriated Value | 1073 | 1132 |  |  | Adjustments to Appropriated Value | -39 |  |  |  | FY 1998 Pres Bud Request | 1034 | 1132 | 1186 | 1237 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 1045  | 1156                          | 1182           | 1214           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 1073  | 1132                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -39   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 1034  | 1132                          | 1186           | 1237           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Project A305   | <i>Page 56 of 66 Pages</i>  | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                            |   |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>A31B</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| A31B Infrared Optics Research   | 2075              | 2233                | 2330                       | 2425  | 2538                | 2637                | 2693                      | 2771                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project sustains the Army's theoretical and experimental research in night vision and electro-optic technologies. It generates new technology to obtain unprecedented awareness of the battlefield to continue to "own the night," notwithstanding increased foreign competition. To achieve these objectives, focal plane arrays with significantly improved performance for major platforms and low cost night vision aids that allow for a wide distribution will be required. Therefore, research is focused on materials, devices and techniques required for the development of high performance smart dual color staring infrared focal plane arrays (IRFPAs) and uncooled IRFPAs with moderate performance. For the high performance IRFPAs, mercury cadmium telluride (HgCdTe) detector arrays and quantum well infrared photon detector (QWIPs) are investigated. Research for uncooled IFRPAs is based on thin film ferro-electric materials and the development of novel detector architectures with improved thermal isolation structures. Uncooled IRFPAs will also have significant civilian applications.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2075 -Fabricated blue/green laser diodes for compact, efficient, visible laser sources and demonstrated room temperature operation for high efficiency pumping of visible laser sources for optical countermeasures and non-lethal weapons.</li> <li style="padding-left: 20px;">-Delivered an optimized, efficient 3-5 mm optical parametric oscillator (OPO) to provide tunable laser output in the required wavelength bands for IR countermeasures (IRCM).</li> </ul> <p>Total 2075</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2233 -Develop processing techniques for thin film ferroelectric materials.</li> <li style="padding-left: 20px;">-Optimize film deposition techniques.</li> <li style="padding-left: 20px;">-Determine optimum application for competing QWIP structures.</li> <li style="padding-left: 20px;">-Demonstrate feasibility of HgCdTe dual color design.</li> </ul> <p>Total 2233</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2330 -Develop thin film ferro-electric detector test structures.</li> <li>• -Demonstrate dual color QWIP detector array with improved quantum efficiency.</li> <li>• -Demonstrate dual color HgCdTe detector array for increased temperature operation.</li> </ul> <p>Total 2330</p> |                   |                     |                            |   |                     |                     |                           |                              |                               |            |
| Project A31B  |                   |                     | <i>Page 57 of 66 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                               |            |

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| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>A31B</b> |
|---|---|-------------------------------|

**FY 1999 Planned Program:**

- 2425 -Demonstrate advanced thin film ferroelectric uncooled IRFPA.  
-Integrate smart pixel technology with QWIP and HgCdTe detector array.
- Total 2425

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 2083           | 2281           | 2326           | 2379           |
| Appropriated Value                | 2141           | 2233           |                |                |
| Adjustments to Appropriated Value | -66            |                |                |                |
| FY 1998 Pres Bud Request          | 2075           | 2233           | 2330           | 2425           |

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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------|------------------------------|------------------------|------------|--|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                     |                              | PROJECT<br><b>B52C</b> |            |  |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |  |
| B52C Mapping and Remote Sensing  | 2408              | 2196                | 2655                | 2763   | 2892                | 3003                | 3066                | 3137                         | Continuing             | Continuing |  |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 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 (Military Engineering Technology), Project A855.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2408 - Investigated techniques to automatically upgrade the accuracy and density of standard (Defense Mapping Agency and US Geological Survey) digital elevation data and designed an open architecture system for processing spectral data to support terrain visualization and environmental monitoring.</li> <li>- Assessed complex neural net architectures for feature extraction and image classification and performed 3-D image compression with wavelet transformations.</li> <li>- Investigated the application of multiple sensors for detecting and monitoring environmental issues; integrated hyperspectral data and imagery with geographic information systems.</li> </ul> <p>Total 2408</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2142 - Perform terrain feature extraction using multispectral/interferometric synthetic aperture radar (IFSAR) data.</li> <li>- Incorporate interactive orthophoto refinement into digital elevation model software.</li> <li>- Study and assess factors contributing to the overall reliability of terrain analysis models.</li> <li>• 54 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2196</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2655 - Develop terrain feature extraction protocols from integrated multispectral/hyperspectral/IFSAR imagery.</li> <li>- Devise neural network image data classification capability.</li> <li>- Examine the effects of the terrain data layers on the reliability of terrain analysis models.</li> </ul> <p>Total 2655</p> |                   |                     |                     |  |                     |                     |                     |                              |                        |            |  |
| Project B52C   |                   |                     |                     | <i>Page 59 of 66 Pages</i>                                       |                     |                     |                     | Exhibit R-2 (PE 0601102A)    |                        |            |  |

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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>B52C</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            2763 - Assess laser-induced fluorescence technologies for extraction of terrain features, targets, and environmental information.</li> <li>                     - Investigate prototype digital elevation model high resolution, large area software.</li> <li>                     - Create reliability coefficients for imagery-derived terrain data layers for use in terrain analysis models.</li> </ul> <p>Total            2763</p>  |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
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|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 2471  | 2612                          | 2663           | 2726           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 2539  | 2196                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -131  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 2408  | 2196                          | 2655           | 2763           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                |                  |                     |  |                  |                  |                           | DATE<br>February 1997  |                  |            |
|---|----------------|------------------|---------------------|--|------------------|------------------|---------------------------|------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                |                  |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                  |                  |                           | PROJECT<br><b>B53A</b> |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate    | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate       | Cost to Complete | Total Cost |
| B53A Battlefield Environment and Signature  | 5407           | 3530             | 3672                | 3822   | 4003             | 4160             | 4249                      | 4378                   | Continuing       | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project 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. The project also includes research in techniques for C<sup>2</sup> natural language and logic-based reasoning systems. The project supports Project Reliance sub-areas of lower atmospheric sciences and terrestrial sciences with a lead role in boundary layer processes and interactions over terrain.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2872 - Developed adaptive optical system for mitigation of severe atmospheric-induced phase distortions affecting optical systems.               <ul style="list-style-type: none"> <li>- Developed 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.</li> <li>- Developed a model for boundary layer coherent structures over vegetation.</li> <li>- Investigated the utility of fluorescence excitation and emission spectra for differentiating between biological and non-biological aerosol.</li> </ul> </li> <li>• 2535 - Incorporated wind effects and turbulence into 3-dimensional acoustic propagation model.               <ul style="list-style-type: none"> <li>- Developed the methodology for mitigation of atmospheric effects in visible color imagery.</li> <li>- Integrated user definable geotypical dynamic terrain into synthetic environments.</li> <li>- Developed dynamic data transformation approach to support real-time visualization of environmental effects.</li> </ul> </li> </ul> <p>Total 5407</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3530 - Perform basic research towards the development of a new generation of self-learning, self-adapting, passive all-optical systems based on neural network principals.               <ul style="list-style-type: none"> <li>- Develop analytical solutions to the coupled nonlinear atmospheric diffusion-advection, Navier-Stokes and propagation equations to provide ultra-fast solutions for obscuration, chemical and biological hazard prediction on the digitized battlefield.</li> <li>- Define and characterize the diurnal behavior of the atmospheric boundary layer.</li> <li>- Develop a laser-based method for rapid point detection of biowarfare agents.</li> <li>- Complete prototype 3-dimensional acoustic propagation model for inclusion into acoustic decision aid.</li> <li>- Develop a complete suite of models for characterization and visualizing the battlespace atmospheric environment.</li> </ul> </li> </ul> <p>Total 3530</p> |                |                  |                     |  |                  |                  |                           |                        |                  |            |
| Project B53A  |                |                  | Page 61 of 66 Pages |  |                  |                  | Exhibit R-2 (PE 0601102A) |                        |                  |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
|---|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> | PROJECT<br><b>B53A</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3672 - Test and validate the boundary layer model of airflow over complex terrain and within and above vegetative canopies and built-up areas for Army tactical scales.             <ul style="list-style-type: none"> <li>- Develop horizontal transient turbulence theory (an alternative method of describing the effects of turbulence, capable of handling the realistic case of multiscale effects in a single step, substantially reducing computation time), including surface layer effects.</li> <li>- Demonstrate the capability of a portable, biowarfare agent, point detector at a major field test in conjunction with the Army Edgewood Research, Development, and Engineering Center; determine fluorescence signatures of polydisperse aerosols.</li> <li>- Incorporate horizontal radiative transport into the boundary layer illumination and radiative balance model to improve contrast calculations for target acquisition.</li> <li>- Complete a prototype 3-D acoustic propagation model for inclusion into acoustic decision aids.</li> <li>- Develop principals for high-resolution, intelligent, adaptive imaging of extended source targets embedded in complex images.</li> </ul> </li> </ul> <p>Total 3672</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1871 - Test and evaluate the boundary layer model for the stable, nocturnal boundary layer.             <ul style="list-style-type: none"> <li>- Develop robust probability distribution functions of turbulence over non-uniform surfaces to enable accurate and timely predictions of transport and diffusion of chemical agents.</li> <li>- Develop a biowarfare agent point detector capable of sorting and collecting suspect biological warfare (BW) agent particles for use in antibody or DNA-based BW agent identifiers; experimentally validate Army models for fluorescence detection of BW aerosols.</li> </ul> </li> <li>• 1951 - Develop a suite of experimental techniques for a state-of-the-art determination of atmospheric contrast transmission for target acquisition.             <ul style="list-style-type: none"> <li>- Determine the effect of limited complex terrain meteorology on atmospheric acoustics.</li> <li>- Develop adaptive control techniques for active imaging using a combined approach based on nonlinear and adaptive optics.</li> </ul> </li> </ul> <p>Total 3822</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5177</td> <td style="text-align: center;">3605</td> <td style="text-align: center;">3678</td> <td style="text-align: center;">3777</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5321</td> <td style="text-align: center;">3530</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+86</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">5407</td> <td style="text-align: center;">3530</td> <td style="text-align: center;">3672</td> <td style="text-align: center;">3822</td> </tr> </tbody> </table> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5177 | 3605 | 3678 | 3777 | Appropriated Value | 5321 | 3530 |  |  | Adjustments to Appropriated Value | +86 |  |  |  | FY 1998 Pres Bud Request | 5407 | 3530 | 3672 | 3822 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 5177   | 3605                         | 3678           | 3777           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 5321   | 3530                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | +86  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 5407   | 3530                         | 3672           | 3822           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Project B53A  | Page 62 of 66 Pages  | Exhibit R-2 (PE 0601102A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>B74A</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| B74A Human Engineering  | 2110              | 2255                | 2620                | 2728   | 2856                | 2966                | 3029                      | 3121                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2110 -Conducted studies addressing human ability to detect, recognize and localize sound sources at various spatial locations in both quiet and noise.               <ul style="list-style-type: none"> <li>-Completed a series of field studies evaluating critical design variables (e.g., field-of-view, ocular configuration, image resolution) affecting the use of night vision devices in military operations.</li> <li>-Conducted studies to examine the relationship between various helmet mounted display options and perceptual fatigue and workload.</li> <li>-Validated noise hazard model for complex waveforms with low frequency components characteristic of armored vehicles and other Army materiel.</li> <li>-Completed development and validation of field practical salivary amylase stress measurement technique; expanded application of procedure to on-going studies of command and control vehicle operations.</li> <li>-Completed a human performance tradeoff analysis of the vision parameters that affect the ability to navigate and drive a teleoperated vehicle.</li> </ul> </li> </ul> <p>Total 2110</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2244 -Continue auditory performance studies addressing human ability to maintain a situation awareness of environments containing multiple sound sources and the effect of practice in detecting and localizing sound signals in noise.               <ul style="list-style-type: none"> <li>-Conduct studies to evaluate critical perceptual variables, (e.g., hyperstereopsis) and its effect on the use of night vision devices in military operations.</li> <li>-Validate noise hazard model with hearing loss data and demonstrate with time-varying middle ear muscle system (long acting waveforms) characteristic of enclosed crew compartments.</li> <li>-Conduct studies on the effects of stress on voice recognition system efficacy.</li> <li>-Further define the vision parameters that affect performance in teleoperation, and develop human driving performance model.</li> </ul> </li> <li>11 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2255</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project B74A  |                   |                     | Page 63 of 66 Pages |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                           |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>B74A</b> |                           |                |
| <b>FY 1998 Planned Program:</b>   |   |                               |                           |                |
| <ul style="list-style-type: none"> <li>• 2620 -Complete report on the effects of spatial separation on the detection and localization of sound signals presented in noise; continue to explore the effects of practice and learning on human auditory performance.</li> <li>-Continue investigation of hyperstereopsis and its effect on visual perception and depth compression.</li> <li>-Conduct a helmet mounted display field study examining design tradeoffs in information display format and the relative impact on soldier cross-country navigation performance.</li> <li>-Continue verification and validation of the noise hazard model with hearing loss data. Demonstrate the previously developed auditory hazard meter in the field for user applications.</li> <li>-Publish report on the effects of stress on voice recognition system efficacy. Initiate studies on the relationship between stress and complex cognitive functioning.</li> <li>-Conduct field studies to assess the human driving performance model and compare driving performance under different sensory feedback conditions.</li> </ul> <p>Total 2620</p>   |   |                               |                           |                |
| <b>FY 1999 Planned Program:</b>   |   |                               |                           |                |
| <ul style="list-style-type: none"> <li>• 2728 - Initiate data collection efforts on human auditory processes in detecting sound in various environments and estimating the distance from the sound source.</li> <li>-Publish results of previous studies examining the interaction effects of field-of-view, ocular configuration, and image resolution on task performance using night vision devices in tactical settings; initiate development of operational metrics for measuring depth perception and visual attention.</li> <li>-Publish results of previous helmet-mounted display studies and initiate an investigation of the attentional conflicts induced by the use of helmet mounted displays.</li> <li>-Develop random incidence corrector and calibration procedures for a "general damage" model. Submit impulse noise standards for Committee on Hearing and Bioacoustics (CHABA) review.</li> <li>-Refine previously developed psychological stress measures and investigate the effects of stress on selected perceptual processes.</li> <li>-Demonstrate a quantitative methodology for measuring operator performance of teleoperated devices and validate in field studies.</li> </ul> <p>Total 2728</p> |   |                               |                           |                |
| <b>B. Project Change Summary</b>  |   |                               |                           |                |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget  | 2388  | 2571                          | 2626                      | 2698           |
| Appropriated Value  | 2454  | 2255                          |                           |                |
| Adjustments to Appropriated Value   | -344  |                               |                           |                |
| FY 1998 Pres Bud Request  | 2110  | 2255                          | 2620                      | 2728           |
| Project B74A  | <i>Page 64 of 66 Pages</i>  |                               | Exhibit R-2 (PE 0601102A) |                |

DATE  
**February 1997**

BUDGET ACTIVITY  
**1 - Basic Research**

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

Change Summary Explanation: Funding: FY 1996 - Funds reprogrammed (-278) to higher priority requirements.  
FY 1997 - Congressional reduction to basic research activities.

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|---|-------------------|---------------------|----------------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                            | PE NUMBER AND TITLE<br><b>0601102A Defense Research Sciences</b> |                     |                     |                           | PROJECT<br><b>B74F</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| B74F Personnel Performance and Training   | 2635              | 2411                | 987                        | 997  | 994                 | 990                 | 987                       | 986                          | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2635 -Continued initiative on training research to improve skill retention and transfer of skills relevant to future battlefields.</li> <li style="padding-left: 20px;">-Completed research on organizational commitment and continued analysis of new leader behavior.</li> <li style="padding-left: 20px;">-Continued research on effects of societal issues on Army morale, cohesion, and retention.</li> </ul> <p>Total 2635</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2352 - Conduct training research on how to improve commander performance. Includes improved thinking and problem solving skills, effective leadership, and communication and control issues in the new, flatter, internetted organizational structures in the digitized battlefield.</li> <li style="padding-left: 20px;">- Conduct training research on impact of spatial abilities on performance in simulated environments (e.g., troops get lost more in simulated worlds than in real one).</li> <li style="padding-left: 20px;">- Conduct research on the effects of stress, as measured by psychophysiological correlates, on elite performance.</li> <li style="padding-left: 20px;">- Analyze effects of peacekeeping service on morale and unit cohesion, and analyze the value of Army service on an individual's future career productivity.</li> <li>• 59 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2411</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 987 -Begin research on skill retention for procedural skills needed in digitized environments.</li> <li style="padding-left: 20px;">-Develop methods for long-term skill retention and rapid reacquisition of skills (especially for mobilized reserves).</li> </ul> <p>Total 987</p> |                   |                     |                            |  |                     |                     |                           |                              |                     |            |
| Project B74F  |                   |                     | <i>Page 65 of 66 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0601102A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|-----|-----|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601102A Defense Research Sciences</b> | <b>PROJECT</b><br><b>B74F</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 997 -Continue research on skill retention for procedural skills needed in digitized environments.</li> <li style="padding-left: 20px;">-Continue research on methods for long-term skill retention and rapid reacquisition of skills.</li> </ul> <p>Total 997</p>  |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2703</td> <td style="text-align: center;">2867</td> <td style="text-align: center;">3029</td> <td style="text-align: center;">3100</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2778</td> <td style="text-align: center;">2411</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-143</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2635</td> <td style="text-align: center;">2411</td> <td style="text-align: center;">987</td> <td style="text-align: center;">997</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 - Congressional reduction to basic research activities.<br/> FY 1998/FY 1999 - Decrease reflects significant restructure of funding for ARI.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2703 | 2867 | 3029 | 3100 | Appropriated Value | 2778 | 2411 |  |  | Adjustments to Appropriated Value | -143 |  |  |  | FY 1998 Pres Bud Request | 2635 | 2411 | 987 | 997 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
| FY 1997 President's Budget   | 2703  | 2867                          | 3029           | 3100           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
| Appropriated Value   | 2778  | 2411                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
| Adjustments to Appropriated Value  | -143  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
| FY 1998 Pres Bud Request   | 2635  | 2411                          | 987            | 997            |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |
| Project B74F   | <i>Page 66 of 66 Pages</i>  | Exhibit R-2 (PE 0601102A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |     |     |

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|---|----------------|------------------|------------------|---|------------------|------------------|------------------|-----------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>              |                |                  |                  | PE NUMBER AND TITLE<br><b>0601104A University and Industry Research Centers</b> |                  |                  |                  |                       |                  |            |
| COST (In Thousands)                                       | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate      | Cost to Complete | Total Cost |
| Total Program Element (PE) Cost                           | 46243          | 44927            | 45576            | 52966   | 55823            | 58016            | 59240            | 61127                 | Continuing       | Continuing |
| BH50 Telecommunications Research                          | 8259           | 6710             | 9160             | 10143   | 10626            | 11044            | 11279            | 11546                 | Continuing       | Continuing |
| BH53 Advanced Distributed Interactive Simulation Research | 0              | 675              | 729              | 745   | 776              | 804              | 819              | 824                   | Continuing       | Continuing |
| BH54 Advanced Sensors Research                            | 8711           | 7100             | 9392             | 10883   | 11401            | 11849            | 12101            | 12599                 | Continuing       | Continuing |
| BH55 Software/Intl Systems Research                       | 974            | 0                | 0                | 0   | 0                | 0                | 0                | 0                     | 0                | 974        |
| BH56 Advanced Displays Research                           | 4695           | 4376             | 4643             | 5272  | 5901             | 6132             | 6261             | 6501                  | Continuing       | Continuing |
| BH59 University Centers of Excellence                     | 4980           | 5676             | 5314             | 6110  | 6398             | 6649             | 6790             | 6948                  | Continuing       | Continuing |
| BH62 Electromechanics and Hypervelocity Physics           | 9139           | 9833             | 8573             | 10532   | 11006            | 11444            | 11689            | 12133                 | Continuing       | Continuing |
| BH64 Materials Center of Excellence                       | 2530           | 2838             | 2384             | 3064  | 3206             | 3331             | 3400             | 3498                  | Continuing       | Continuing |
| BH65 Microelectronics Center of Excellence                | 2430           | 2838             | 2492             | 3063  | 3206             | 3332             | 3400             | 3497                  | Continuing       | Continuing |
| BH73 National Automotive Center of Excellence             | 4525           | 4881             | 2889             | 3154  | 3303             | 3431             | 3501             | 3581                  | Continuing       | Continuing |

**Mission Description and Budget Item Justification:** The Army's initiative to create three open, federated laboratories is an innovative and forward thinking approach focusing the talents of industry and academia on critical technology needs of the Army. The federated laboratory is a partnership between the Army Research Laboratory (ARL) and the private sector involving cooperative agreements, integrated management and staff rotation, education and communication. The basic construct of a federated laboratory is to continue strong in-house involvement to meet Army-unique requirements where there is little external expertise in the technologies, 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 formed partnerships with consortia consisting of at least one each of an industrial company, a major university, and a Historically Black College or University/Minority Institution (HBCU/MI). Long-term cooperative agreements (5 years) were established in three key areas,

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  | PE NUMBER AND TITLE<br><b>0601104A University and Industry Research Centers</b> |                              |
| <p>and these consortia have become “virtual labs” within ARL and function like any other ARL division. Research jointly planned and executed and Army scientists and engineers are intermingled through long term assignments with the consortia. The federated laboratory approach for ARL is in accordance with the 1991 Base Realignment and Closure, and the Department of Defense mandate to exploit private sector research and reduce infrastructure. This program element also includes the Army's Centers of Excellence, which are the centerpiece of academic linkage to Army R&amp;D organizations. Centers of Excellence continue to be an integral part of the Army's research investment strategy, along with single investigator programs and Army laboratory research. Centers have proven to be highly effective in many applications-oriented projects, in areas such as rotary wing technology and electronics. Centers couple state-of-the-art research programs with broad-based graduate education programs to increase the supply of scientists and engineers in areas of Army importance. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and DoD Project Reliance. 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.</p> |   |                              |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>BH50</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| BH50 Telecommunications Research   | 8259              | 6710                | 9160                | 10143  | 10626               | 11044               | 11279                     | 11546                        | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project establishes long term collaboration between the Army Research Laboratory and competitively selected industry/university consortia headed by Lockheed Sanders, Nashua, NH, for the purpose of leveraging world class research relevant to Army needs. Battlefield telecommunications involve the reliable, timely, and secure electronic transport of multi-media information over heterogeneous, digital networks exhibiting dynamic topologies. The technical areas addressed under this project are: wireless battlefield digital communications; tactical/strategic interoperability; information distribution; multi-media concepts.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 8259 -Initiated research in wireless battlefield digital communications, tactical/strategic interoperability, information distribution and multimedia concepts.</li> </ul> <p>Total 8259</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6546 -Investigate secure, high-capacity multiple access schemes. <ul style="list-style-type: none"> <li>-Investigate scaleable techniques for network self-organization, connectivity tracking, resources allocation, and mobility management.</li> <li>-Develop realistic models for heterogeneous networks.</li> <li>-Develop methods for formal specification and testing of communications, control, and network management.</li> <li>-Investigate techniques for providing data format independence for the organization, maintenance, synchronization, and access of heterogeneous information.</li> <li>-Investigate joint source coding and packet reconstruction techniques for distributing multimedia over corrupted channels.</li> <li>-Develop data compression algorithms with high resolution, low complexity, low latency, and context sensitivity.</li> <li>-Develop efficient algorithms for intermedia and interparticipant multimedia synchronization.</li> </ul> </li> <li>• 164 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 6710</p> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project BH50   |                   |                     | Page 3 of 25 Pages  |  |                     |                     | Exhibit R-2 (PE 0601104A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH50</b> |                |                |
| <b>FY 1998 Planned Program:</b>   |  |                               |                |                |
| <ul style="list-style-type: none"> <li>• 9160 -Develop and demonstrate protocols that support seamless connectivity between satellite and terrestrial segments.</li> <li style="padding-left: 20px;">-Evaluate the applicability of ATM technology to multi-rate battlefield wireless environments.</li> <li style="padding-left: 20px;">-Develop formal testing and validation methodologies for network simulation models.</li> <li style="padding-left: 20px;">-Develop and demonstrate an executable-code encoded hybrid network simulation.</li> <li style="padding-left: 20px;">-Develop and demonstrate techniques to support push-pull flow control among information servers based on real-time network events.</li> <li style="padding-left: 20px;">-Develop and demonstrate scalable multimedia compression techniques which track the rate-distortion curve as the rate is reduced by traffic or bandwidth.</li> </ul> <p>Total 9160</p>  |  |                               |                |                |
| <b>FY 1999 Planned Program:</b>   |  |                               |                |                |
| <ul style="list-style-type: none"> <li>• 10143 -Develop and demonstrate alternative signaling protocols for call hand-off, origination, delivery, and internet protocol mobility in a highly mobile environment.</li> <li style="padding-left: 20px;">-Develop and demonstrate a network management system based on a next-generation, software-based, fault-tolerant distributed object computing platform and a multi-tier network architecture.</li> <li style="padding-left: 20px;">-Demonstrate tactical information distribution technology that incorporates fact-exchange protocols, adaptive flow control and routing, meta data queries, and user-controllable threshold criteria.</li> <li style="padding-left: 20px;">-Demonstrate packetization and error recovery methods for multimedia communications over highly corrupted channels.</li> <li style="padding-left: 20px;">-Demonstrate intermedia and interparticipant multimedia synchronization using submillisecond time synchronization.</li> </ul> <p>Total 10143</p> |  |                               |                |                |
| <b>B. Project Change Summary</b>  |  |                               |                |                |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget  | 8472   | 9081                          | 10022          | 10260          |
| Appropriated Value  | 8710   | 6710                          |                |                |
| Adjustments to Appropriated Value   | -451   |                               |                |                |
| FY 1998 Pres Bud Request  | 8259   | 6710                          | 9160           | 10143          |
| Change Summary Explanation: Funding: FY 1997-Congressional reduction for Federated Laboratories.  |  |                               |                |                |
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| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH53</b> |
|---|--|-------------------------------|

| COST (In Thousands)                                       | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| BH53 Advanced Distributed Interactive Simulation Research | 0              | 675              | 729              | 745              | 776              | 804              | 819              | 824              | Continuing       | Continuing |

**A. Mission Description and Justification:** The Army Center of Excellence in Information Sciences (ACEIS) at Clark Atlanta University (HBCU/MI) will perform basic (6.1) research in information science within its designated research areas. The research focuses on the mid to far-term needs of information systems for the Army. The program addresses enabling and applied technologies to use new and emerging technologies to meet the needs of a digital force in the 21st Century. It performs research in information science with emphasis in the following areas: interactive and intelligent systems; database and information systems; and distributed and parallel systems. Current research activities align with the Digitization and Communication Sciences Research Program in the software and intelligent systems and the information distribution areas. Work in this project was previously accomplished in PE 0601102A/BH57.

**FY 1996 Accomplishments:** Project not funded in FY 96

**FY 1997 Planned Program:**

- 658 - Develop training Neural Networks for forecasting battlefield weather conditions, logistics distribution problems, and other areas.  
- Develop algorithms to study stability properties of communications systems.  
- Develop data model tools/techniques for complex systems such as command and control systems.
- 17 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 675

**FY 1998 Planned Program:**

- 729 -Develop test bed for virtual environments.  
-Apply intelligent data base capabilities to Army logistics problems.  
-Apply parallel processing techniques to tactical command and control.

Total 729

**FY 1999 Planned Program:**

- 745 -Extend virtual environments using neural nets and fuzzy logic. Incorporate advanced data mining techniques into intelligent data base capabilities.  
-Investigate technologies for information distribution in a wireless mobile environment.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |                               |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                              | <b>PROJECT</b><br><b>BH53</b> |                |
| Total  | 745  |                              |                               |                |
| <b><u>B. Project Change Summary</u></b>  |  |                              |                               |                |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u>                | <u>FY 1999</u> |
| FY 1997 President's Budget   | 0  | 690                          | 617                           | 702            |
| Appropriated Value   |  | 675                          |                               |                |
| Adjustments to Appropriated Value  |  |                              |                               |                |
| FY 1998 Pres Bud Request   | 0  | 675                          | 729                           | 745            |
| Change Summary Explanation: Funding: FY 1998 -Funding increased (+101) to maintain adequate funding for an HBCU/MI Center of Excellence. |  |                              |                               |                |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                           |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                           | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>BH54</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate       | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| BH54 Advanced Sensors Research  | 8711              | 7100                | 9392                      | 10883  | 11401               | 11849               | 12101                     | 12599                        | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project establishes long term collaboration between the Army Research Laboratory and a competitively selected industry/university consortia headed by Lockheed Sanders, Nashua, NH, for the purpose of leveraging world class research relevant to Army needs. Advanced sensors are the elements of systems that view the environment and convert the basic raw sensor data into meaningful information suitable for transmission over tactical networks. The technical areas addressed under this project are: multidomain smart sensors, to include multispectral infrared focal plane arrays; multisensor fusion automatic target recognition algorithms, to include synthesis of sensor modeling; radar sensors, to include atmospheric and terrain effects on propagation; and signal processing, capitalizing on commercially available hardware.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 8711 -Developed integrated program plan with detailed short-term and long-term (3-5 years) goals; developed ARL/consortium work structures supporting workpackages and scientific coordination process; and initiated design based on device application analysis, as well as fabrication of components for Multi-Quantum Well (MQW) detector structure.</li> </ul> <p>Total 8711</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3462 - Complete design of multispectral MQW device; investigate laser radar (LADAR) active imaging concepts, identifying means for integrating laser/detector structures; and determine practical limits of single active/passive imaging system with regard to the extent of spectral bands.<br/>- Define performance of enhanced performance low-light-level imager (e.g., extended low-wave cut off, and design low-power integrated processing).</li> <li>• 3464 - Demonstrate signal processing for Multi-Domain Smart Sensors (MDSS) using off chip hardware and selected algorithms.<br/>- Deliver baseline Forward Looking Infrared/Synthetic Aperture Radar algorithm and three sensor signature/scene modeling environments.<br/>- Evaluate the effectiveness of various target discrimination features for a foliage penetration radar; develop techniques to synthesize clutter data by extrapolating/interpolating from existing millimeter wave clutter data bases.</li> </ul> <p>174 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</p> <p>Total 7100</p> |                   |                     |                           |  |                     |                     |                           |                              |                               |            |
| Project BH54  |                   |                     | <i>Page 7 of 25 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0601104A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b>  | <b>PROJECT</b><br><b>BH54</b> |                |                |
| <b>FY 1998 Planned Program:</b>   |   |                               |                |                |
| • 9392  | -Develop bench demonstration of Multi-Domain Smart Sensor (MDSS), select recognition algorithms for on-chip processing.<br>-Complete a 3-sensor image processing environment addressing concealment, camouflage and deception (CC&D), obscuration, and articulation.<br>-Complete selected millimeter wave (MMW) common module sub-assemblies, test low angle tracking algorithms, complete phenomenological description of foliage penetration radar; develop and test feature sets for ground penetrating radar; design wide-band digital beamformer.<br>-Integrate hybrid optical signal processor/digital signal processor (OSP/DSP) into testbed; demonstrate 10x improvement in size, speed, power; resolve on-chip processing trade-offs for MDSS.<br>-Complete low-power advanced imaging unattended ground sensor (AIUGS) and define appropriate algorithms. |                               |                |                |
| Total 9392  |   |                               |                |                |
| <b>FY 1999 Planned Program:</b>   |   |                               |                |                |
| • 10883   | -Complete fabrication of large area multi-color focal plane and components for active imaging; implement selected algorithms in integrated circuit structures.<br>-Complete a 4-sensor image processing environment.<br>-Deliver a complete set of MMW common modules and integrate into a fully functional testbed configuration; insert upgrades into ARL ultra-wide band (UWB) testbed for use in elevated conditions and conduct foliage penetrations/ground penetration (FOPEN/GPEN) experiments to study algorithm effectiveness.<br>-Demonstrate hybrid OSP/DSP for specific application; demonstrate 30x improvement in size, speed and power.<br>-Develop processing hardware for AIUGS; develop network algorithms for target detection and tracking.   |                               |                |                |
| Total 10883   |   |                               |                |                |
| <b>B. <u>Project Change Summary</u></b>   |   |                               |                |                |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget  | 8935  | 9758                          | 10755          | 11163          |
| Appropriated Value  | 9187  | 7100                          |                |                |
| Adjustments to Appropriated Value   | -476  |                               |                |                |
| FY 1998 Pres Bud Request  | 8711  | 7100                          | 9392           | 10883          |
| Change Summary Explanation: Funding: FY 1997-Congressional decrease (-2658) for basic research activities.<br>FY 1998-Funding reprogrammed (-1363) to higher priority requirements. |   |                               |                |                |
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| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           | <b>PROJECT</b><br><b>BH55</b> |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| BH55 Software/Intl Systems Research   | 974               | 0                   | 0                   | 0  | 0                   | 0                   | 0                         | 0                             | 0                   | 974        |
| <p><b>A. <u>Mission Description and Justification</u>:</b> This project provides funding for the Army High Performance Computing Research Center (AHPCRC), located at the University of Minnesota. This center addresses research needs in high performance computing (HPC), including advanced algorithms and software technology and evaluation of novel computing environments, and provides for HPC training and the development of human resources. The program includes partners from Clark Atlanta, Florida A&amp;M, Howard, and Jackson State Universities (all Historically Black Colleges and Universities). This includes collaborative research with ARL scientists in the areas of computational fluid dynamics, simulation, advanced manufacturing and materials science, environmental sciences, biotechnology, information technology, and algorithms and software development. The exploitation of emerging scalable computing technology is crucial to the Army, providing timely, accurate modeling and design information to enhance the development of complex, sophisticated weapons systems relying more on computational modeling. Funding for AHPCRC will be provided in PE 0601102A/Project AH48 in FY 1997 and beyond.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 974 - Extended multi-body modeling capability for paratrooper jumping from a tactical aircraft (in collaboration with Natick RDEC).             <ul style="list-style-type: none"> <li>- Demonstrated modeling capability for fluid-structure interaction and the effect of gun component vibration on the firing cycle of the regenerative liquid propellant gun (RLPG).</li> <li>- Demonstrated predictive capability for reacting flows appropriate for hypervelocity flight.</li> <li>- Established capability for porous media flow including adsorption and reaction effects (in collaboration with Corps of Engineers Waterways Experiment Station (CEWES)).</li> </ul> </li> </ul> <p>Total 974</p> <p><b>FY 1997 Planned Program:</b> Funded in PE 0601102A/Project AH48.</p> <p><b>FY 1998 Planned Program:</b> Funded in PE 0601102A/Project AH48 .</p> <p><b>FY 1999 Planned Program:</b> Funded in PE 0601102A/Project AH48.</p> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |
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| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                |                           | <b>PROJECT</b><br><b>BH55</b> |
| <b><u>B. Project Change Summary</u></b>  | <u>FY 1996</u>   | <u>FY 1997</u> | <u>FY 1998</u>            | <u>FY 1999</u>                |
| FY 1997 President's Budget   | 0  | 0              | 0                         | 0                             |
| Appropriated Value   | 0  |                |                           |                               |
| Adjustments to Appropriated Value  | +974   |                |                           |                               |
| FY 1998 Pres Bud Request   | 974  | 0              | 0                         | 0                             |
| Change Summary Explanation: Funding: FY 1996 - Project established (+974) to address research needs in high performance computing. |  |                |                           |                               |
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| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           |                              | PROJECT<br><b>BH56</b> |            |  |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |  |
| BH56 Advanced Displays Research  | 4695              | 4376                | 4643                | 5272  | 5901                | 6132                | 6261                      | 6501                         | Continuing             | Continuing |  |
| <p><b>A. Mission Description and Justification:</b> This project establishes a competitively selected university/industry consortium headed by Rockwell International Corporation, Cedar Rapids, IA, to provide solutions for the many requirements for information assimilation on the battlefield. Displays and control constructs are the interface between human users and computers. This consortium will develop display subsystem architecture which can provide access to all information of practical use, provide data visualization in an efficient manner and use the advanced hardware and software technologies to address the human sensory modality without overloading the user and degrading performance. Work in this project differs from DARPA's program, which aims to establish a domestic capability for display hardware. The technical areas being addressed under this project are: human-computer interface in an information rich environment; display configuration, real time visualization, architecture, information presentation, and control coupling.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4695 -Initiated research in human-computer interface in an information rich environment; initiated research in display configuration. Conducted research involving real time visualization, architecture and information presentation.</li> </ul> <p>Total 4695</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4269 -Demonstrate operational data planning displays; develop algorithms for managing objects in 3-D Battlefield Visualization databases and displays; develop scalable techniques to identify and schedule information for displays that maximize value of information.             <ul style="list-style-type: none"> <li>- Investigate the techniques for presentation and interaction with terrain and battle-related information on virtual reality displays; develop reliable object alignment systems to resolve registration problems with Augmented Reality.</li> <li>-Implement design guidelines for development of components to enhance a soldier's ability to understand multiple messages, which increases situational awareness in a minimized time span; develop methods to predict potential enemy courses of action and consequences of tactical options.</li> <li>- Investigate the architectures for integration of speech, gesture and gaze in display control for hands-free operations.</li> <li>-Develop principles of multimodal displays and controls.</li> <li>- Investigate the display stabilization methods and architectures for using display in moving platforms; implement noise cancellation techniques to enhance speech recognition in noisy environments.</li> <li>-Refine and validate current Display Description Language (DDL) evaluation metrics and develop new multidimensional metrics.</li> <li>-Develop novel image compression methods specifically tailored for distributed databases with multiple display resolutions.</li> </ul> </li> <li>107 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program.</li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                        |            |  |
| Project BH56   |                   |                     | Page 11 of 25 Pages |   |                     |                     | Exhibit R-2 (PE 0601104A) |                              |                        |            |  |

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH56</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p>Total 4376</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4643 -Implement a virtual battlefield testbed; implement capabilities supporting visualization of 3-D battlefields, including a prototype system for intelligent information filtering. Integrate architecture with CECOM Digital Integration Lab (DIL).<br/>                     -Develop techniques for assignment of value functions to information objects; develop scheduling algorithms that maximize value and define interface for transport of information to display system.<br/>                     -Implement architectures for integration of speech, gesture and gaze in display control; develop methodology to utilize tactile information; develop prototype components for user-sensitive auditory displays for rapid message understanding and situation awareness.<br/>                     -Demonstrate research results in Advanced Technology Demonstrations (ATDs), Prairie Warrior, Logistics Anchor Desk or Tactical Operations Center (TOC).<br/>                     -Correlate subjective information display metrics with objective display measurements to develop basis for automated display resolution evaluations.<br/>                     -Develop method for determining level of alertness and response to critical visual information; develop principles of virtual displays of combat-related information.</li> </ul> <p>Total 4643</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5272 -Implement visual presentation language; integrate architectures for integration of speech, gesture and gaze in display control; integrate value function techniques into information presentation architectures; integrate value function techniques into information presentation architectures. Continue validation of consortium findings in Army operational environments, including Force XXI; integrate display stabilization methods in Army moving platforms programs such as C2V, M1A1 and M2.<br/>                     -Implement automated display resolution evaluation techniques, scheduling algorithms and assimilation architectures; integrate decision support prediction methodologies into architectures.<br/>                     -Implement principles for development of virtual displays of combat-related information, to facilitate accurate perception and representation of the information; integrate 3-D model based image compression coding system into information presentation and assimilation architecture.</li> </ul> <p>Total 5272</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4815</td> <td style="text-align: center;">4735</td> <td style="text-align: center;">5241</td> <td style="text-align: center;">5371</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4950</td> <td style="text-align: center;">4376</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-255</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4695</td> <td style="text-align: center;">4376</td> <td style="text-align: center;">4643</td> <td style="text-align: center;">5272</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4815 | 4735 | 5241 | 5371 | Appropriated Value | 4950 | 4376 |  |  | Adjustments to Appropriated Value | -255 |  |  |  | FY 1998 Pres Bud Request | 4695 | 4376 | 4643 | 5272 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 4815   | 4735                          | 5241           | 5371           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 4950   | 4376                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -255   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 4695   | 4376                          | 4643           | 5272           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project BH56   |  | Exhibit R-2 (PE 0601104A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

DATE  
**February 1997**

BUDGET ACTIVITY  
**1 - Basic Research**

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

Change Summary Explanation: Funding: FY 1998- Funding reprogrammed (-598) to higher priority requirements.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>BH59</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| BH59 University Centers of Excellence  | 4980              | 5676                | 5314                | 6110   | 6398                | 6649                | 6790                      | 6948                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> The Army's University Centers of Excellence (COE) provide loci for focused research in areas of strategic importance. Army Centers of Excellence are active in the fields of rotary-wing technology, advanced fuel cell technology, the foundations of image science, and science, mathematics and engineering (SME) education of minority students. 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2510 - Completed integration of the Rotorcraft Centers of Excellence (RCOE) into the National Rotorcraft Technology Center ( NRTC). Awarded new cooperative agreements to Georgia Institute of Technology, Pennsylvania State University and University of Maryland. Initiated program addressing the research topics of efficient low-noise rotors, integrated product and process development including virtual prototyping and advanced distributed simulation, low-vibration dynamic systems, advanced drivetrains, smart and composite structures, day/night adverse weather capability, highly-reliable safe operations and digital-optical integrated flight controls.             <ul style="list-style-type: none"> <li>- Concluded research by the Mathematical Sciences Institute focusing on computational algebra, stochastic analysis and nonlinear wave high resolution simulation.</li> </ul> </li> <li>• 2470 - Developed the scientific foundations of object recognition at Washington University and established metrics for background clutter, image complexity and algorithm performance.             <ul style="list-style-type: none"> <li>- Advanced training technology research at Morris Brown College through research in computer simulation training in cooperation and team performance, and critical decision making.</li> <li>- Established a Center of Excellence for Science, Mathematics, and Engineering (SME) Education at Contra Costa College to strengthen academic programs in SME and attract underrepresented minority students to these programs.</li> </ul> </li> </ul> <p>Total 4980</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3737 - Continue NRTC RCOE cooperative program addressing the research topics of efficient low-noise rotors, integrated product and process development including virtual prototyping and advanced distributed simulation, low-vibration dynamic systems, advanced drivetrains, smart and composite structures, day/night adverse weather capability, highly-reliable safe operations and digital-optical integrated flight controls.</li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project BH59   |                   |                     | Page 13 of 25 Pages |  |                     |                     | Exhibit R-2 (PE 0601104A) |                              |                               |            |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |  | DATE<br>February 1997     |
|--|--|---------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE                                      | PROJECT                   |
| <b>1 - Basic Research</b>  | <b>0601104A University and Industry Research Centers</b> | <b>BH59</b>               |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 1800 - Advance image analysis research through investigations of object recognition at Washington University and establish metrics for background clutter, image complexity and algorithm performance.</li> <li>• 1800 - Advance fuel cell and advanced battery research at the Illinois Institute of Technology with emphasis on lithium-ion/metal oxide and nickel/hydrate batteries and direct oxidation methanol fuel cells.</li> <li>• 1800 - Conclude training technology research at Morris Brown College focused on computer simulation training in cooperation and team performance, and critical decision making.</li> <li>• 1800 - Support SME education at Contra Costa College to strengthen academic programs in SME and attract underrepresented minority students to these programs.</li> <li>• 139 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5676</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2600 - Continue NRTC RCOE cooperative program addressing the research topics of efficient low-noise rotors, integrated product and process development including virtual prototyping and advanced distributed simulation, low-vibration dynamic systems, advanced drivetrains, smart and composite structures, day/night adverse weather capability, highly-reliable safe operations and digital-optical integrated flight controls.</li> <li>• 2600 - Advance image analysis research at Washington University to develop knowledge and model-based systems, Bayesian models and optimization of fundamental metrics for object recognition.</li> <li>• 2714 - Advance fuel cell and advanced battery research at Illinois Institute of Technology with emphasis on lithium-ion/metal oxide and nickel/hydrate batteries and direct oxidation methanol fuel cells.</li> <li>• 2714 - Support SME education at Contra Costa College to strengthen undergraduate SME academic programs and attract under-represented minority students to these programs.</li> <li>• 2714 - Establish a multi-disciplinary research program to model human performance to enhance soldier performance on the digitized battlefield.</li> </ul> <p>Total 5314</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2800 - Continue NRTC RCOE cooperative program addressing the research topics of efficient low-noise rotors, integrated product and process development including virtual prototyping and advanced distributed simulation, low-vibration dynamic systems, advanced drivetrains, smart and composite structures, day/night adverse weather capability, highly-reliable safe operations and digital-optical integrated flight controls.</li> <li>• 2800 - Advance image analysis research at Washington University to establish the fundamental limits of the performance of automatic recognition systems.</li> </ul> |  |                           |
| Project BH59   | Page 14 of 25 Pages                                      | Exhibit R-2 (PE 0601104A) |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH59</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 3310 - Conclude research on fuel cells and advanced research at the Illinois Institute of Technology.             <ul style="list-style-type: none"> <li>- Support SME education at Contra Costa College to strengthen undergraduate SME academic programs and attract under-represented minority students to these programs.</li> <li>- Continue a multi-disciplinary research program to model human performance to enhance soldier operational effectiveness on the digitized battlefield.</li> </ul> </li> </ul> <p>Total            6110</p>  |  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5807</td> <td style="text-align: center;">5797</td> <td style="text-align: center;">6029</td> <td style="text-align: center;">6228</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5970</td> <td style="text-align: center;">5676</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-990</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4980</td> <td style="text-align: center;">5676</td> <td style="text-align: center;">5314</td> <td style="text-align: center;">6110</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996-Funding reprogrammed (-680) to higher priority requirements; Congressional general reductions and rescissions (-147).</p> <p style="padding-left: 100px;">FY 1998-Funding reprogrammed (-715) to higher priority requirements.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5807 | 5797 | 6029 | 6228 | Appropriated Value | 5970 | 5676 |  |  | Adjustments to Appropriated Value | -990 |  |  |  | FY 1998 Pres Bud Request | 4980 | 5676 | 5314 | 6110 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 5807   | 5797                          | 6029           | 6228           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 5970   | 5676                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -990   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 4980   | 5676                          | 5314           | 6110           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p>Project BH59 <span style="float: right;">Page 15 of 25 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0601104A)</span></p>  |  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>BH62</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| BH62 Electromechanics and Hypervelocity Physics   | 9139              | 9833                | 8573                | 10532  | 11006               | 11444               | 11689                     | 12133                        | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 a University Affiliated Research Center, the Institute for Advanced Technology (IAT), at the University of Texas. Electromechanics and hypervelocity physics support critical Army research relating to electromechanical systems (EM launchers and power supplies) for applications to electromagnetic (EM) and electrothermal-chemical (ETC) guns. Additionally, this project provides for research, testing and computer modeling of advanced hypervelocity (HV) projectiles. In keeping with the Army Electric Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power and on establishing the utility of hypervelocity. The sum of these focused efforts serves as a catalyst for technological innovation and provides crucial support to the Army technology base for advanced weapons systems development with potential applications for anti-armor, artillery and air defense.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 9139 - Conducted focused experiments on the effects of rail gouging during EM launch; conducted studies of high performance materials in an attempt to identify optimum performance of armature/rail pairs and high dielectric strength insulators; conducted experiments focused on improving launch efficiency; validated EMAP3D code and initiated expansion to include sliding electrical contact interface model; conducted studies to identify and develop improved diagnostics for in-barrel and on-board EM/HV launchers.             <ul style="list-style-type: none"> <li>- Conducted focused experiments to address the issue of HV utility in the anti-armor role; conducted experiments in HV penetration mechanics and lethality in conjunction with ARL sponsor and Defense Research Agency (UK); conducted studies of HV novel penetrator designs; validated advanced computational codes for modeling HV penetrator structural and aerophysical behavior.</li> <li>- Planned and conducted the 8th International Electromagnetic Launch Symposium and a Pulsed Power Short Course (expanded and updated) for Army scientists and engineers; continued operating technical information center; hosted high school interns and West Point cadets for summer EM/HV research projects.</li> <li>- Conducted studies to identify fundamental issues facing pulsed power development and to determine possible solutions; conducted assessments of technological alternatives to rotating machines including integrated pulse forming networks and linear magnetic flux compressors; evaluated high energy density dielectrics for capacitors.</li> </ul> </li> </ul> <p>Total            9139</p> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project BH62  |                   |                     | Page 16 of 25 Pages |  |                     |                     | Exhibit R-2 (PE 0601104A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH62</b> |
| <b>FY 1997 Planned Program:</b>  |  |                               |
| <ul style="list-style-type: none"> <li>• 9656 - Conduct studies and provide critical information on gouging, armature/rail interface interactions, performance of hybrid armatures, high performance materials for EM applications and improved railgun efficiency; conduct integrated launch package modeling and feasibility tests; perform medium scale testing for solid armature designs; validate the updated version of EMAP3D code and add a stress module.</li> <li>- Conduct experiments to demonstrate mass-velocity tradeoff studies of advanced penetrators against reactive targets. Select and perform feasibility demonstrations for most promising novel kinetic energy penetrator designs.</li> <li>- Plan and conduct Electric Gun Theory Short Course (updated and expanded) and Pulse Power II Short Course; continue operating technical information center; continue summer intern and West Point cadet summer research programs, develop materials and conduct peer reviews in preparation for next Electromagnetic Launch (EML) Symposium.</li> <li>- Conduct assessments of critical pulsed power components and systems with emphasis on high speed/high stress performance; work with industry and other research organizations to foster development of the most promising concepts; assess potential of new high temperature super conducting materials for magnetic energy storage in pulsed power applications; assess performance of propellant-driven flux compressors for generation of millisecond high current pulses; evaluate advances in fast-turn-off vacuum and solid state switches.</li> <li>177 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 9833</p>  |  |                               |
| <b>FY 1998 Planned Program:</b>  |  |                               |
| <ul style="list-style-type: none"> <li>• 8573 - Conduct tests to obtain critical data on gouging, armature/rail interface interactions, armature performance, launch packages using a sub-scale (medium caliber) EM launcher and to validate the novel models for predicting launch package behavior at or above 2.5 km/sec; use advanced diagnostic techniques developed in previous years to perform non-intrusive measurements required to validate complex models.</li> <li>- Continue to conduct laboratory experiments on sub-scale hypervelocity penetrators of novel configurations to determine their effectiveness against multiple spaced plates, explosive reactive armors and advanced armor materials and configurations; perform sub-scale tests and evaluations/studies which will clearly demonstrate the utility and/or advantages of hypervelocity penetrators as replacements for conventional kinetic energy (KE) and depleted uranium (DU) penetrators.</li> <li>- Plan and conduct Hypervelocity Physics II and Advanced Materials courses; continue to update the data base of the technical information center dedicated to electric gun technologies and hypervelocity physics; expand the summer apprentice and West Point Cadet summer intern projects; conduct a high school out-reach project to encourage young students to pursue careers in science and technology, conduct EML Symposium.</li> <li>- Continue to identify and assess a variety of pulsed power alternatives; recommend the best options for use in an all electric Future Combat System (FCS); assist the Army in working with industry to demonstrate that a practical compact pulsed power system can be mated to an ETC or EM gun; provide the Army with a comprehensive simulation tool for assessing the system efficiency of an integrated electric gun system on a fieldable platform.</li> </ul> <p>Total 8573</p> |  |                               |
| Project BH62   |  |                               |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|-------|-------|--------------------|-------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|-------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH62</b> |                |                |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 10532 - Investigate methods to further improve railgun efficiency and barrel life including zoned or laminate/composite rail and barrel concepts, novel launcher configurations, advanced armatures and transition control; conduct experiments to establish a minimum mass launch package and tests to ensure acceptable armature/sabot separation and flight characteristics; begin to consolidate existing validated codes developed for separate parts of the EM launcher into a prototype "virtual railgun" simulation to be used as a tool for designing/developing future railgun systems.</li> <li>- Conduct studies and experiments at near full-scale to optimize the performance of selected KE penetrator concepts against multiple spaced plates, explosive reactive armors advanced armor materials and integrated complex targets; conduct studies to ensure desired flight characteristics at velocities at or above 2.5 km/sec; evaluate designs for EM launch packages and hypervelocity penetrators using models and simulations; further demonstrate the utility of hypervelocity and the benefits of hypervelocity penetrators.</li> <li>- Plan and conduct Advanced Pulsed Power Course II; provide electric armaments community with up-to-date technical reports and information through the facilities at the Technical Information Center; coordinate West Point Cadet summer intern program; expand high school out-reach project.</li> <li>- Study and recommend innovative fabrication concepts, new materials and techniques for improving construction of multi-pole rotating machines to optimize performance; develop output power management techniques to provide maximum system efficiency; continue development and testing of alternative pulse power sources including flux compressors; provide basic test data on new vacuum and solid state switch concepts for electric armaments; conduct studies on advanced test concepts for rotor containment in vehicles under field conditions.</li> </ul> <p>Total        10532</p> |  |                               |                |                |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9734</td> <td style="text-align: center;">8443</td> <td style="text-align: center;">10397</td> <td style="text-align: center;">11753</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">10007</td> <td style="text-align: center;">9833</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-868</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">9139</td> <td style="text-align: center;">9833</td> <td style="text-align: center;">8573</td> <td style="text-align: center;">10532</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Funding increased by Congress (+1400) for research relating to electromechanical systems.<br/> FY 1998- Funding reprogrammed (-1824) to higher priority requirements.<br/> FY 1999- Funding reprogrammed (-1221) to higher priority requirements.</p>   |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9734 | 8443 | 10397 | 11753 | Appropriated Value | 10007 | 9833 |  |  | Adjustments to Appropriated Value | -868 |  |  |  | FY 1998 Pres Bud Request | 9139 | 9833 | 8573 | 10532 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| FY 1997 President's Budget   | 9734   | 8443                          | 10397          | 11753          |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Appropriated Value   | 10007  | 9833                          |                |                |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Adjustments to Appropriated Value  | -868   |                               |                |                |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| FY 1998 Pres Bud Request   | 9139   | 9833                          | 8573           | 10532          |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Project BH62   | Page 18 of 25 Pages  | Exhibit R-2 (PE 0601104A)     |                |                |                |                |                |                            |      |      |       |       |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |  |
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           |                              | PROJECT<br><b>BH64</b> |            |  |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |  |
| BH64 Materials Center of Excellence  | 2530              | 2838                | 2384                | 3064  | 3206                | 3331                | 3400                      | 3498                         | Continuing             | Continuing |  |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project promotes long-term collaboration between the ARL Materials Directorate and University/Industry Research Centers for the purpose of conducting world class research and exploiting fundamental breakthroughs in materials science relevant to Army needs. Basic research in materials science and engineering is focused on the Army's armor, armament and soldier protective mission and related Defense Strategic Research Objectives. Collaborative research agreements facilitate a dynamic environment for innovative programs and continuing exchange of scientific talent and equipment needed to achieve long-range research objectives. The project currently emphasizes advanced materials characterization, composite materials, and dendritic polymers research for lightweight, structural armor and armaments; integrated and multifunctional composites; chemical/biological barrier materials and other critical applications.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2530 - Conducted research in corrosion effects and protection of alloys.</li> <li style="padding-left: 20px;">- Developed interface and high temperature property measurements in metal matrix composites.</li> <li style="padding-left: 20px;">- Developed non-destructive characterization of polymer matrix composite materials.</li> </ul> <p>Total 2530</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2769 - Continue research in corrosion effects and protection of alloys.</li> <li style="padding-left: 20px;">- Continue development of interface and high temperature property measurements in metal matrix composites.</li> <li style="padding-left: 20px;">- Continue to develop non-destructive characterization of polymer matrix composite materials.</li> </ul> <p style="padding-left: 20px;">69 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</p> <p>Total 2838</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 684 -Extend technique and transport model to characterize penetrant permeation in multicomponent, block copolymers.</li> <li style="padding-left: 20px;">-Develop microstructural-based models for matrix-reinforcement interactions and dynamic fracture processes in Metal Matrix Composites (MMCs).</li> <li style="padding-left: 20px;">-Investigate novel electrochemical techniques and laser-based ultrasonics for deposition and non-destructive characterization (NDC) of thin, protective films.</li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                        |            |  |
| Project BH64   |                   |                     | Page 19 of 25 Pages |   |                     |                     | Exhibit R-2 (PE 0601104A) |                              |                        |            |  |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH64</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 850 -Investigate in-situ bonding between dissimilar polymer materials and inorganic substrates during resin transfer molding (RTM) processing.<br/>-Develop atomic-scale models for polymer carbon-fiber interphase formation and microstructure-property prediction.<br/>-Investigate constitutive relationships contributing to damage tolerance of thick-section integral armor.</li> <li>• 850 -Develop molecular models which discriminate dendrimer core vs. surface physical-chemical properties.<br/>-Synthesize and investigate structure-property behavior of silicon-containing dendrimers and dendrigaft polymers.<br/>-Extend the knowledge base for use of dendrimer as resin modifiers.</li> </ul> <p>Total 2384</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1050 -Develop experimental and theoretical understanding of penetrant transport behavior in smart, selective barrier materials.<br/>-Extend nondestructive characterization techniques to assess smart sensor/actuators effects on composite material lifetimes.<br/>-Develop diagnostic methods and predictive models for in-situ, real-time monitoring and control of ceramic densification.</li> <li>• 1014 -Model fiber-resin interphase formation and chemistry/microstructure to dynamics of strength and durability.<br/>-Explore novel concepts for enhancing delamination toughness of integrated and 3-D thick-section composites.<br/>-Establish fundamental understanding of effects of composite material properties on ballistic performance.</li> <li>• 1000 -Extend theoretical models to predict molecular dynamics and self-assembling characteristics of dendritic polymers.<br/>-Design and synthesize "smart" dendritic polymers and investigate structure-property relationships.<br/>-Design, synthesize and assess dendritic polymers which are elastomeric or enhance the barrier properties of elastomers.</li> </ul> <p>Total 3064</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2903</td> <td style="text-align: center;">2899</td> <td style="text-align: center;">2886</td> <td style="text-align: center;">2877</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2985</td> <td style="text-align: center;">2838</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-455</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2530</td> <td style="text-align: center;">2838</td> <td style="text-align: center;">2384</td> <td style="text-align: center;">3064</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996- Funding reprogrammed (-300) to higher priority requirements; Congressional general reductions and rescissions (-73).<br/>FY 1998- Funding reprogrammed (-502) to higher priority requirements.</p> <p>Project BH64 <span style="float: right;">Page 20 of 25 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0601104A)</span></p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2903 | 2899 | 2886 | 2877 | Appropriated Value | 2985 | 2838 |  |  | Adjustments to Appropriated Value | -455 |  |  |  | FY 1998 Pres Bud Request | 2530 | 2838 | 2384 | 3064 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 2903   | 2899                          | 2886           | 2877           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 2985   | 2838                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -455   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 2530   | 2838                          | 2384           | 3064           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                        |            |  |
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0601104A University and Industry Research Centers</b> |                     |                     |                     |                              | PROJECT<br><b>BH65</b> |            |  |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |  |
| BH65 Microelectronics Center of Excellence  | 2430              | 2838                | 2492                | 3063  | 3206                | 3332                | 3400                | 3497                         | Continuing             | Continuing |  |
| <p><b>A. <u>Mission Description and Justification:</u></b> The Microelectronics Research Collaborative Program (MCRP) will establish a long term collaboration between ARL Physical Sciences Directorate and universities to ensure a seamless, synergistic cooperative work environment to provide the Army the key technologies and analytical support necessary to assure supremacy in future land warfare. The goals of this effort are to conduct innovative research and exploit new concepts in solid-state physics, electronics engineering and chemical/electrochemical engineering, and provide mutual exchange of public and private sector researchers working at each other's institutions. The technical areas being addressed under this project are: Nanoelectronics/Optoelectronics; Electrochemistry/Energy Science; Biological/Chemical Detection; High Frequency and Quasi-optical Electronics; Piezoelectronics; Microelectromechanics.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2430 - Performed research and development of membranes for methanol fuel cells and investigation of molecular transport mechanisms. Studied the synthesis and process of carbon electrodes for charged storage applications.</li> <li>- Determined selected physical properties of piezoelectric materials to support manufacturing science in acoustic microtechnology. Researched and developed quartz microsensor arrays.</li> <li>- Performed research related to the synthesis and deposition of electroluminescent polymers for high resolution, flat panel display applications.</li> <li>- Studied new concepts and recent advances in microelectromechanical devices, ultra-miniature sensors, actuators, transducers, and microresonators.</li> <li>- Researched materials, optical sources, detectors, waveguides and optoelectronic integrated circuits for optical signal processing and optoelectronic component technology to advance the state of the art in communications and aided-target recognition.</li> </ul> <p>Total 2430</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2769 - Continue research and development of membranes for methanol fuel cells and investigation of molecular transport mechanisms. Study the synthesis and process of carbon electrodes for charged storage applications.</li> <li>- Continue research to determine selected physical properties of piezoelectric materials to support manufacturing science in acoustic microtechnology. Research and develop quartz microsensor arrays.</li> <li>- Perform research related to the synthesis and deposition of electroluminescent polymers for high resolution, flat panel display applications.</li> <li>- Exploit new concepts and advances in microelectromechanical devices, ultra-miniature sensors, actuators, transducers, and microresonators for smart, lightweight, inexpensive battlefield sensors.</li> </ul> |                   |                     |                     |   |                     |                     |                     |                              |                        |            |  |
| Project BH65  |                   |                     |                     | Page 21 of 25 Pages   |                     |                     |                     | Exhibit R-2 (PE 0601104A)    |                        |            |  |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH65</b> |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Research materials, optical sources, detectors, waveguides and optoelectronic integrated circuits for optical signal processing and optoelectronic component technology to advance the state-of-the-art in communications and aided-target recognition.</li> <li>69 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total            2838</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            2492 -Perform research in ultra-small/nano-scale electronic/photonic device structures addressing modeling, materials, nanofabrication, characterization, and measurement of performance for high-speed signal processing.</li> <li style="padding-left: 40px;">-Investigate heterostructures, materials, optical sources, detectors, waveguides, phase shifters, and optoelectronic integrated circuits for optical signal processing and optoelectronic component technology.</li> <li style="padding-left: 40px;">-Study device physics of optoelectronic (OE) devices as well as design, fabrication, radio frequency (RF)/optics integration and optical interconnects.</li> <li style="padding-left: 40px;">-Investigate the device physics, fabrication methods, and characterization of electronic and OE devices operating in the millimeter-wave, terahertz, and light-wave domains for radar, communications-on-the-move, and target acquisition.</li> <li style="padding-left: 40px;">-Explore new materials, components and fabrication techniques to improve performance, increase safety, and reduce life-cycle costs of high density primary and rechargeable batteries and fuel cells for man-portable applications.</li> <li style="padding-left: 40px;">-Conduct fundamental research into new classes of chemical/biological microminiature sensors interfaced with micro-optoelectronic circuitry, multi-toxin sensor arrays, and ultra-sensitive detection materials for miniature, low-cost detectors.</li> </ul> <p>Total            2492</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            3063 -Leverage university resources to provide state-of-the art research in microelectronics technology for 21st century Army systems. Areas of interest include nanoelectronics, optoelectronics, photonics, traditional and alternative power sources, piezoelectric materials, wide-band-gap semiconductors, and microelectromechanical devices.</li> <li style="padding-left: 40px;">-Continue to provide opportunities for staff rotation, advanced degrees for Army researchers, and a state-of-the-art research environment to ensure Army technological superiority in communications, navigation, and surveillance capability.</li> </ul> <p>Total            3063</p> |  |                               |
| Project BH65  | <i>Page 22 of 25 Pages</i>   | Exhibit R-2 (PE 0601104A)     |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  |                           |                | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> |                           |                | <b>PROJECT</b><br><b>BH65</b> |
| <b>B. <u>Project Change Summary</u></b>   | <u>FY 1996</u>   | <u>FY 1997</u>            | <u>FY 1998</u> | <u>FY 1999</u>                |
| FY 1997 President's Budget  | 2903   | 2899                      | 2886           | 2877                          |
| Appropriated Value  | 2985   | 2838                      |                |                               |
| Adjustments to Appropriated Value   | -555   |                           |                |                               |
| FY 1998 Pres Bud Request  | 2430   | 2838                      | 2492           | 3063                          |
| <p>Change Summary Explanation: Funding: FY 1996- Funding reprogrammed (-400) to higher priority requirements; Congressional general reductions and rescissions (-73).</p> <p style="padding-left: 100px;">FY 1998- Funding reprogrammed (-394) to higher priority requirements.</p> |  |                           |                |                               |
|   |  |                           |                |                               |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                            |   |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>1 - Basic Research</b>  |                   |                     |                            | PE NUMBER AND TITLE<br><b>0601104A University and Industry Research Centers</b> |                     |                     |                           |                              | PROJECT<br><b>BH73</b> |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| BH73 National Automotive Center of Excellence   | 4525              | 4881                | 2889                       | 3154  | 3303                | 3431                | 3501                      | 3581                         | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> The Center of Excellence for Automotive Research, established in 1994, is a key element of the basic research module of the National Automotive Center (NAC), located at the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC). The Center of Excellence for Automotive Research is an innovative university/industry/government consortium leveraging commercial dual use technology for the Army through on-going and new programs in automotive research, allowing significant cost savings while maximizing technological productivity. The selected university partners include: University of Michigan, University of Iowa, University of Wisconsin, Wayne State University, and Howard University, while key industry partners include the "Big Three" U.S. automotive manufacturers.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4525 -Completed preliminary, unique state-of-the-art powertrain cycle simulation model applicable to both commercial and military vehicles (i.e. dual-need.)</li> <li>-Finalized expanded network of industrial partners comprising 35 automotive-related companies including the U.S. "Big Three."</li> <li>-Performed significant analysis optimizations on High Mobility Multi-purpose Wheeled Vehicles and Family of Medium Tactical Vehicles.</li> <li>-Initiated experimental validation of vehicle simulation models.</li> <li>-Initiated development of unique dual-need virtual prototyping infrastructure.</li> </ul> <p>Total 4525</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4761 -Complete initial simulation models related to off-road dual-need vehicle dynamics.</li> <li>-Develop unique structural analysis techniques related to component performance and reliability.</li> <li>-Continue experimental validation of vehicle simulation models.</li> <li>-Continue development of dual-need virtual prototyping infrastructure.</li> <li>• 120 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4881</p> |                   |                     |                            |   |                     |                     |                           |                              |                        |            |
| Project BH73  |                   |                     | <i>Page 24 of 25 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0601104A) |                              |                        |            |

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>1 - Basic Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0601104A University and Industry Research Centers</b> | <b>PROJECT</b><br><b>BH73</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2889 -Complete overall vehicle simulation model.</li> <li style="padding-left: 20px;">-Complete dual-need virtual prototyping infrastructure.</li> <li style="padding-left: 20px;">-Continue experimental validation of models using state-of-the-art transient prototypes.</li> </ul> <p>Total 2889</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3154 -Complete optimization of dual-need overall simulation network.</li> <li style="padding-left: 20px;">-Complete experimental validation of fully functional system model using advanced hardware prototypes.</li> <li style="padding-left: 20px;">-Finalize detailed mechanism of effective government, industry and academia partnering and provide recommendations for future relevant tasks.</li> </ul> <p>Total 3154</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4848</td> <td style="text-align: center;">2986</td> <td style="text-align: center;">3063</td> <td style="text-align: center;">3143</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4985</td> <td style="text-align: center;">4881</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-460</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4525</td> <td style="text-align: center;">4881</td> <td style="text-align: center;">2889</td> <td style="text-align: center;">3154</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Funding increased by Congress (+1895) for automotive research programs.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4848 | 2986 | 3063 | 3143 | Appropriated Value | 4985 | 4881 |  |  | Adjustments to Appropriated Value | -460 |  |  |  | FY 1998 Pres Bud Request | 4525 | 4881 | 2889 | 3154 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 4848   | 2986                          | 3063           | 3143           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 4985   | 4881                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -460   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 4525   | 4881                          | 2889           | 3154           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project BH73   | Page 25 of 25 Pages  | Exhibit R-2 (PE 0601104A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |



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|--|-------------------|---------------------|--------------------------|---|---------------------|---------------------------|---------------------|------------------------------|------------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |   |                     |                           |                     | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                          | PE NUMBER AND TITLE<br><b>0602105A Materials Technology</b> |                     |                           |                     |                              | PROJECT<br><b>AH84</b> |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| AH84 Materials   | 9858              | 14530               | 9811                     | 10979   | 11547               | 12765                     | 13504               | 13387                        | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Budget Item Justification:</u></b> This project provides the technical foundation for materials technology in metals, ceramics, polymers, and composites essential for the optimum use of these materials in 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 individual soldier support equipment, armor, armaments, aircraft, ground and combat vehicles, and combat support. Development efforts are focused in armor/armament materials, as well as lightweight structural materials and materials affording protection against chemical, biological, or directed energy threats. Areas of study in these developments are in characterization, to include high strain rate characterization, processing, and fabrication of these materials. Additional efforts provide materials solutions for improved performance, durability, and cost reduction in Army unique systems. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3600 -Determined dynamic response (constitutive relationships) of ceramic and polymer composite materials for application in ultra lightweight personnel protection.<br/>-Determined dynamic responses and residual strength properties for emerging composite armor materials applicable to combat and helicopter systems.</li> <li>• 4876 -Developed analytical tools (modeling, hardware and design data base) for life prediction and deterioration control of polymers in plastics, rubbers, coatings and composite/hybrid materials leading to significant operations and support (O&amp;S) cost reduction.<br/>-Developed intelligent imaging systems for non-destructive evaluation (NDE) of materials used in electronic components.<br/>-Investigated wear and erosion effects on current and future gun systems.</li> <li>• 730 -Demonstrated performance of thick film, low loss, phase shifter materials at 15 Ghz for high performance, low cost radar antenna applications.<br/>-Characterized near optimal tungsten materials for replacement of depleted uranium in kinetic energy penetrators.</li> <li>• 652 - Applied Non-Destructive Evaluation (NDE) methods to characterize flaws and failures in: a) the Composite Armored Vehicle (CAV) hull, and b) multi-layered dielectric materials.<br/>- Improved Mission Intensity Counter (MIC) with increased data acquisition rates and state variable modifications.<br/>- Completed dynamic model of A-6 landing gear using Dynamic Analysis and Design System (DADS) software.</li> </ul> <p>Total 9858</p> <p><b>FY 1997 Planned Program:</b></p> |                   |                     |                          |   |                     |                           |                     |                              |                        |            |
| Project AH84   |                   |                     | <i>Page 1 of 3 Pages</i> |   |                     | Exhibit R-2 (PE 0602105A) |                     |                              |                        |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |
|---|---|------------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602105A Materials Technology</b> | PROJECT<br><b>AH84</b>       |
| <ul style="list-style-type: none"> <li>• 4050 -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.</li> </ul> <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>-Correlate lightweight materials' dynamic properties to improvements in ballistic response for application in ultralightweight personnel protection.</li> <li>-Investigate novel approaches to combining low cost titanium and other lightweight materials for incorporation into future armor and Army systems.</li> </ul> <ul style="list-style-type: none"> <li>• 5831 -Demonstrate improved protective coatings, including chemical agent resistant coating (CARC), meeting all military requirements for armament, ammunition, ground support equipment and aircraft.</li> <li>-Demonstrate gun tube life enhancement by using protection schemes developed to reduce the attack of advanced propellant systems on conventional and improved gun systems.</li> <li>-Combine sensor based manufacturing techniques and on-board life monitoring for use in manufacture of composite components with greater logistic supportability for future armored vehicles.</li> <li>-Demonstrate performance of thick film, low loss phase shifter materials for applications at 25 Ghz for an extremely low cost, lightweight radar antenna.</li> </ul> <ul style="list-style-type: none"> <li>• 3895 -Develop composite materials for use in ballistic missile structures.</li> <li>• 676 - Evaluate, assess, and determine the limits of different NDE methods for use on CAV thick polymer sections and other CAV components.</li> <li>- Develop maneuver recognition software for the MIC using fuzzy logic.</li> <li>- Initiate Cooperative Research and Development Agreement (CRDA) on aircraft brake-induced vibration; model the vibration of constrained layer damped beams with a new viscous higher-order beam theory.</li> </ul> <ul style="list-style-type: none"> <li>78 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 14530</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3325 -Provide component ferroelectric material for full scale phase shift antenna test to industry. License ferroelectric formulation patents.</li> <li>-Produce transparent armor material in a prototype configuration.</li> <li>-Develop refractory metal based warhead liners using novel processing.</li> <li>-Provide modeling and simulation codes as guidelines to improving the ballistic resistance of ultra lightweight armor material.</li> <li>-Provide the Army with reduced signature camouflage CARC paint meeting all low Volatile Organic Compounds (VOC) requirements for tactical and aviation equipment.</li> </ul> |   |                              |
| Project AH84  | Page 2 of 3 Pages   | Exhibit R-2 (PE 0602105A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |
|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602105A Materials Technology</b> | <b>PROJECT</b><br><b>AH84</b> |                |                |                |                |                |                            |      |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |
| <ul style="list-style-type: none"> <li>• 5858 -Evaluate novel processing methods for improved chemical resistance of polymers/elastomers.<br/>             -Develop integral composite structures that combine structural capabilities with ballistic performance without collateral damage.<br/>             -Develop novel armor plate and ballistically tolerant metallic materials using laser processing.<br/>             -Provide guidelines through modeling and simulation codes for enhancing ballistic penetration capabilities of materials.<br/>             -Perform ballistic validation of hybrid (intermetallic) laminate preforms.</li> </ul> <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>628 - Develop pattern recognition for acoustic emission (AE) and acousto-ultrasonic measurements for inspecting thick composite structures.<br/>             - Apply laser ultrasonic inspection system to flaw detection and characterization; validate smart structure model for estimating changes in elastic coefficients.<br/>             - Flight test the MIC; conduct brake-induced vibration tests, and initiate tests of ground vehicle suspension systems.</li> </ul> <p>Total 9811</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5750 -Demonstrate enhanced ballistic performance and dynamic response of ultra lightweight armor materials.<br/>             -Demonstrate transparent armor material in a prototype component.<br/>             -Demonstrate advanced polymeric/barrier materials that offer improved performance and durability in Army chemical defense applications.<br/>             -Develop computer models that determine the structural as well as ballistic performance of complex composite material systems.<br/>             -Optimize processing of fabricating ballistically resistant hybrid laminate.</li> <li>• 4526 -Develop rapid prototyping of ballistically tolerant novel components via laser processing.<br/>             -Develop processing techniques for fabrication of nanomaterials for penetrators.<br/>             -Produce thick film ferroelectric tape cast specimens for traveling wave antenna.<br/>             -Develop rubber bushings and roadwheel materials to enable track systems to extend their service life by 100%.</li> <li>• 703 - Validate AE and acousto-ultrasonic NDE on CAV.<br/>             - Develop 3D finite element analysis for microwave NDE of composites; extend NDE technologies to real time detection of material degradation.<br/>             - Investigate active suspension systems for ground vehicles and aircraft, and develop vibration control algorithms.</li> </ul> <p>Total 10979</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9901</td> <td style="text-align: center;">10841</td> <td style="text-align: center;">11582</td> <td style="text-align: center;">12101</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">10176</td> <td style="text-align: center;">14530</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-318</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9901 | 10841 | 11582 | 12101 | Appropriated Value | 10176 | 14530 |  |  | Adjustments to Appropriated Value | -318 |  |  |  |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |
| FY 1997 President's Budget  | 9901   | 10841                         | 11582          | 12101          |                |                |                |                            |      |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |
| Appropriated Value  | 10176  | 14530                         |                |                |                |                |                |                            |      |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |
| Adjustments to Appropriated Value   | -318   |                               |                |                |                |                |                |                            |      |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |
| Project AH84  | Page 3 of 3 Pages  | Exhibit R-2 (PE 0602105A)     |                |                |                |                |                |                            |      |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |

DATE  
**February 1997**

BUDGET ACTIVITY  
**2 - Applied Research**

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

**B. Project Change Summary**

FY 1998 Pres Bud Request

| <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|----------------|----------------|----------------|----------------|
| 9858           | 14530          | 9811           | 10979          |

Change Summary Explanation:

Funding: FY 1997 additional funds appropriated by Congress (+4000) for hardened materials.

FY 1998 funds reprogrammed (-1786) to higher priority requirements.

FY 1999 funds reprogrammed (-1122) to higher priority requirements.

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) |                |                  |                  |  |                  |                  |                  | DATE<br>February 1997 |                  |            |
|---|----------------|------------------|------------------|--|------------------|------------------|------------------|-----------------------|------------------|------------|
| BUDGET ACTIVITY<br>2 - Applied Research             |                |                  |                  | PE NUMBER AND TITLE<br>0602120A Sensors and Electronic Survivability |                  |                  |                  |                       |                  |            |
| COST (In Thousands)                                 | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate      | Cost to Complete | Total Cost |
| Total Program Element (PE) Cost                     | 26675          | 19351            | 19294            | 19682  | 19535            | 20651            | 20867            | 21353                 | Continuing       | Continuing |
| AH15 Ground Combat Identification Technology        | 3291           | 3604             | 3532             | 3552   | 3438             | 3584             | 3671             | 3769                  | Continuing       | Continuing |
| AH16 S3I Technology                                 | 16571          | 13151            | 12992            | 13116  | 13094            | 13913            | 14015            | 14345                 | Continuing       | Continuing |
| AH25 Nuclear Effects Survivability Technology       | 4380           | 0                | 0                | 0  | 0                | 0                | 0                | 0                     | 0                | 9196       |
| A140 High Power Microwave (HPM) Technology          | 2433           | 2596             | 2770             | 3014   | 3003             | 3154             | 3181             | 3239                  | Continuing       | Continuing |

**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.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b> |                     |                     |                           | PROJECT<br><b>AH15</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AH15 Ground Combat Identification Technology  | 3291              | 3604                | 3532                | 3552  | 3438                | 3584                | 3671                      | 3769                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This program provides the enabling technology necessary to demonstrate advanced combat identification (CI) 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 not only reduced fratricide but also a significant increase in combat effectiveness. CI is also strongly related to the Army's larger objective of battlefield digitization and synergistically supplements that effort by feeding friendly position information from the platform level into the command and control network.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3291 - Developed improved conceptual prototype hardware for combat identification for the dismounted soldier (CIDDS), completed initial technical field testing of prototype approaches, initiated technology down selection process, and provided assistance to Infantry School on requirements definition.</li> <li>- Conducted initial force-on-force modeling of candidate ground-to-ground and air-to-ground combat ID systems including the dismounted soldier.</li> <li>- Completed low fidelity initial simulation of air-to-ground CI alternatives, developed virtual simulation of battlefield combat identification system (BCIS) digital data link (DDL), and initiated development of simulation tools for dismounted soldier.</li> </ul> <p>Total 3291</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3527 - Complete virtual simulation of BCIS DDL, complete constructive modeling of air-to-ground CI systems, and complete initial virtual and constructive simulations of dismounted soldier CI system.</li> <li>- Demonstrate prototype CIDDS systems in an operational field experiment sponsored by the Dismounted Battlespace Battle Lab (DBBL) and determine best technical approach for both Land Warrior integrated CIDDS function and stand-alone CIDDS system for other dismounted soldiers. Initiate integration into Land Warrior system and transition to engineering and manufacturing development (EMD) for stand-alone system.</li> <li>- Support source selection and evaluation board (SSEB) and Milestone I/II for dismounted soldier ID system.</li> </ul> <p>77 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</p> <p>Total 3604</p> <p><b>FY 1998 Planned Program:</b></p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project AH15  |                   |                     | Page 2 of 11 Pages  |   |                     |                     | Exhibit R-2 (PE 0602120A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602120A Sensors and Electronic Survivability</b> | <b>PROJECT</b><br><b>AH15</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <ul style="list-style-type: none"> <li>• 3532 - Complete integration of CIDDS function into Land Warrior equipment suite and demonstrate as part of Force XXI Land Warrior early user testing under the consolidated Land Warrior program.</li> </ul> <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Analyze and develop target ID concepts for the remaining engagement scenarios for the dismounted soldier, to include soldier-to-vehicle, vehicle-to-soldier and helicopter-to-soldier.</li> <li>- Improve the model fidelity for the chosen CI air, ground and dismounted soldier solutions to support validation of techniques, tactics and procedures (TTPs), create leave-behind training capabilities, and support requirements definition and technology selection for the Land Warrior.</li> </ul> <p>Total 3532</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3552 - Complete prototyping and initiate and complete integration of the CI functions for the dismounted soldier, to include soldier-to-vehicle, vehicle-to-soldier and helicopter-to-soldier.</li> <li>- Complete virtual simulation experiments of the complete CI architecture.</li> </ul> <p>Total 3552</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">3615</td> <td style="text-align: center;">3686</td> <td style="text-align: center;">3532</td> <td style="text-align: center;">3552</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3615</td> <td style="text-align: center;">3604</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-324</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">3291</td> <td style="text-align: center;">3604</td> <td style="text-align: center;">3532</td> <td style="text-align: center;">3552</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 3615 | 3686 | 3532 | 3552 | Appropriated Value | 3615 | 3604 |  |  | Adjustments to Appropriated Value | -324 |  |  |  | FY 1998 Pres Bud Request | 3291 | 3604 | 3532 | 3552 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 3615   | 3686                          | 3532           | 3552           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 3615   | 3604                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -324   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 3291   | 3604                          | 3532           | 3552           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AH15  | Page 3 of 11 Pages   | Exhibit R-2 (PE 0602120A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                |                  |                    |   |                  |                  |                           | DATE<br>February 1997  |                  |            |
|---|----------------|------------------|--------------------|---|------------------|------------------|---------------------------|------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                |                  |                    | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b> |                  |                  |                           | PROJECT<br><b>AH16</b> |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate       | Cost to Complete | Total Cost |
| AH16 S3I Technology   | 16571          | 13151            | 12992              | 13116   | 13094            | 13913            | 14015                     | 14345                  | Continuing       | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides for the synergistic development of sensors, signal 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 bandwidth to be compatible with Army communication systems; (6) concept validation of the passive MMW camera. Project goals in the smart munitions and fuzing sensor area include development of advanced microwave, millimeter wave (MMW), acoustic, electrostatic, and LADAR technologies to reliably sense low-cross section targets in high countermeasures and clutter environments. These technologies support the Force XXI modernization efforts, the Army battlefield digitization effort, ATDs/ACTDs such as: Intelligent Minefield; Target Acquisition; Remote Sentry; Rapid Force Project Initiatives; and systems such as: Longbow; advanced submunitions, standoff fuzing for anti-armor munitions, proximity fuzing, range finding for bursting munitions, smart mines, multi-option fuze for artillery; guided and unguided tank, mortar and artillery ammunition; and anti-aircraft applications including projectile and missile fuzing.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5833 - Developed refined automatic detection capability for concealed targets using UWB synthetic aperture radar (SAR) data by exploiting unique phenomenology; conducted measurements program on near surface metal and plastic mines using transportable testbed. <ul style="list-style-type: none"> <li>- Performed efficient multi-mode waveform processing, using direct digital synthesis and open architecture signal processing; quantified cost savings for future systems.</li> <li>- Developed advanced target/clutter separation techniques for RISTA and fire control radar applications based on use of neural net and genetic training techniques; evaluated concepts for self-regulating algorithm to sense cluttered background.</li> <li>- Tested and characterized the ambiguity optical processor and developed algorithms and architecture for the multi-role survivable radar (MRSR) testbed.</li> </ul> </li> <li>• 4446 - Added MMW radar data as the second sensor for ATR algorithms; developed new 10 class model based multi-sensor recognition algorithms; and investigated the performance and data requirement issues related to a SAR/thermal image multi-sensor ATR. <ul style="list-style-type: none"> <li>- Developed low cost, enhanced target engagement sensor technologies, including microwave, electrostatic and global positioning system (GPS) for future Army systems; developed design of GPS receiver suitable for projectile firing (very high gravity environment).</li> </ul> </li> </ul> |                |                  |                    |   |                  |                  |                           |                        |                  |            |
| Project AH16  |                |                  | Page 4 of 11 Pages |   |                  |                  | Exhibit R-2 (PE 0602120A) |                        |                  |            |



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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b>  | PROJECT<br><b>AH16</b>       |
| <b>FY 1996 Accomplishments: (continued)</b>                    |  |                              |
|  | <ul style="list-style-type: none"> <li>- Developed 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.</li> <li>- Investigated techniques for providing near-field target signature by purely analytical means; evaluated MMW radar tracking algorithms for armored targets at extended ranges.</li> </ul>  |                              |
| • 6292   | <ul style="list-style-type: none"> <li>- Conducted experiments with Battle Labs to validate the utility of integrating the terrain and environmental reasoning spatial database and tactical event detection and synchronization software.</li> <li>- Completed development and field test of first and second generation modular, concept validation passive MMW camera.</li> </ul>   |                              |
| Total  | 16571  |                              |
| <b>FY 1997 Planned Program:</b>                                |  |                              |
| • 6490   | <ul style="list-style-type: none"> <li>- 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.</li> <li>- Implement advanced waveform processing in software and benchmark; evaluate adding advanced moving target indication (MTI) and stationary target indication (STI) algorithms to processor suite.</li> <li>- 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.</li> </ul> |                              |
| • 4358   | <ul style="list-style-type: none"> <li>- Develop algorithms and architectures for image processing and demonstrate two-dimensional optical processors with high throughput.</li> <li>- 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.</li> <li>- Demonstrate GPS performance for projectiles and missiles. Develop LADAR for smart munitions applications.</li> <li>- Expand acoustic real time tracking and identification to include a broader base of ground and air targets.</li> </ul>  |                              |
| • 2303   | <ul style="list-style-type: none"> <li>- 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.</li> <li>- Prototype and evaluate multi-level situational awareness agents that will operate over a distributed computing environment.</li> </ul>   |                              |
| Total  | 13151  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 4751   | <ul style="list-style-type: none"> <li>-Demonstrate target acquisition and tracking of ground vehicles using 35 Ghz wideband polarimetric testbed.</li> <li>-Report on capability to perform UWB SAR processing steps in real-time on an airborne platform.</li> <li>-Demonstrate stationary target discrimination techniques for real beam radars that increase probability of detection in diverse environments.</li> </ul>  |                              |
| Project AH16   | <i>Page 5 of 11 Pages</i>  | Exhibit R-2 (PE 0602120A)    |

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|--|---|------------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b> | PROJECT<br><b>AH16</b>       |
| <ul style="list-style-type: none"> <li>• 2369 -Demonstrate two-dimensional imager with on-chip processing in hybrid optical/digital architecture running detection and identification algorithms.</li> </ul> <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 1475 -Extend the operational envelope of SAR ATR approaches to robustly address the full variation of sensor geometrics provided by operational sensors.<br/>-Double synthetic scene generation speed while maintaining physical realism.</li> <li>• 2867 -Conduct test firings of GPS tracking of artillery projectiles.<br/>-Develop acoustic algorithms to track large target formations.<br/>-Complete brassboard frequency modulated/continuous wave (FM/CW) LADAR with low-cost architecture in an armaments RDEC submunition configuration.</li> <li>• 1530 -Evaluate and transition multi-level reasoning and situational awareness agents within the battlefield visualization advanced technology demonstration (ATD).<br/>-Exploit improved processing and algorithms for the real-time transformation of sensor and environmental information into a unified battlefield visualization.</li> </ul> <p>Total      12992</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4685 -Integrate second generation STI algorithms into wideband testbed.<br/>-Report on performance of UWB SAR algorithms to provide reliable discrimination of mines in clutter.<br/>-Improve stationary target classification for real beam radars by using adaptively weighted mean square error metrics and efficient multi-resolution template pruning strategies.</li> <li>• 2342 -Demonstrate smart imager in hybrid optical digital architecture running real-time algorithms on imager data with reduced power requirements.</li> <li>• 2676 -Demonstrate acoustic target formation tracking.<br/>-Develop low-cost high resolution three-dimensional radar imaging for munitions.<br/>-Complete comprehensive testing and analysis of LADAR to demonstrate applicability to ARDEC submunition scenarios.</li> <li>• 1450 -Perform multi-sensor cross cueing studies between SAR ATR and moving target indicator/electro-optic (MTI/EO) sensors for unmanned aerial vehicle (UAV)-borne multi-sensor SAR payloads.<br/>-Model urban-type clutter in the visible, infrared and millimeter wave in high resolution synthetic scenes.</li> <li>• 1963 -Extend software agent concept to include seamless information access over complex heterogeneous multi-databases.<br/>-Develop prototype to validate real-time transformation of sensor and environmental information with terrain, unit and control to measure battlefield visualization.</li> </ul> <p>Total      13116</p> |   |                              |
| Project AH16   |   | Exhibit R-2 (PE 0602120A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  |                |                           | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>          | <b>PE NUMBER AND TITLE</b><br><b>0602120A Sensors and Electronic Survivability</b> |                |                           | <b>PROJECT</b><br><b>AH16</b> |
| <b><u>B. Project Change Summary</u></b>                        | <u>FY 1996</u>   | <u>FY 1997</u> | <u>FY 1998</u>            | <u>FY 1999</u>                |
| FY 1997 President's Budget                                     | 16635  | 12455          | 12950                     | 14223                         |
| Appropriated Value   | 17162  | 13151          |                           |                               |
| Adjustments to Appropriated Value                              | -591   |                |                           |                               |
| FY 1998 Pres Bud Request                                       | 16571  | 13151          | 12992                     | 13116                         |
|  |  |                |                           |                               |
| Project AH16   | Page 7 of 11 Pages   |                | Exhibit R-2 (PE 0602120A) |                               |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b> |                     |                     |                           | PROJECT<br><b>AH25</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AH25 Nuclear Effects Survivability Technology  | 4380              | 0                   | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                   | 9196       |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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. The analysis tools developed by this project produce the analyses used to support the independent evaluation process for acquisition milestones decisions. This project will provide cost effective solutions for the rapidly growing threat of nuclear weapons technology proliferation in the Third World. This project has been coordinated with the Defense Nuclear Agency and other military services in the DoD Nuclear Technology Area Plan to avoid duplication of effort and maximize return on investment.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3123 - Developed test methodologies for radiation survivability of advanced commercial integrated circuits, new static random access memories (SRAMs) and, using the scale model electromagnetic facility, for composite structures.             <ul style="list-style-type: none"> <li>- Examined non-linear materials as potential smart composite shield materials and demonstrated composite shielding concept.</li> <li>- Calculated radiation shielding effectiveness for a composite armored vehicle and calculated internal blast on massively parallel processing (MPP) computers.</li> <li>- Determined non-ideal blast parameters for use in nuclear survivability criteria and specified techniques that will mitigate non-ideal blast effects on personnel and equipment.</li> </ul> </li> <li>• 1257 - Updated working version of nuclear blast codes from experiments and computer analysis design tools.</li> </ul> <p>Total 4380</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project AH25   |                   |                     | Page 8 of 11 Pages  |   |                     |                     | Exhibit R-2 (PE 0602120A) |                              |                     |            |

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|--|---|------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b> | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b> | PROJECT<br><b>AH25</b> |
|--|---|------------------------|

| <b>B. <u>Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|---|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget              | 4452           | 4816           | 5821           | 5908           |
| Appropriated Value                      | 4576           | 0              |                |                |
| Adjustments to Appropriated Value       | -196           |                |                |                |
| FY 1998 Pres Bud Request                | 4380           | 0              | 0              | 0              |

Change Summary Explanation: Funding: FY 1997-out: Project eliminated. Army will leverage technology from Defense Nuclear Agency.

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b> |                     |                     |                           | PROJECT<br><b>A140</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A140 High Power Microwave (HPM) Technology  | 2433              | 2596                | 2770                | 3014  | 3003                | 3154                | 3181                      | 3239                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 US equipment. This program is coordinated and, when appropriate, leveraged with HPM programs in the Air Force, Navy, Defense Nuclear Agency, National Labs, university consortia and relevant industry and foreign partners.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2433 - Conducted 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.               <ul style="list-style-type: none"> <li>- Conducted HPM hardening technology development and demonstrations centering on completion of microwave/millimeter integrated circuit (MMIC) on-chip limiters for US Army Space and Strategic Defense Command and for selected systems.</li> <li>- Developed HPM tools (sources/components) for indoor/outdoor experimentation including antennas and pulsed power amplifiers with a focus on development of the wideband klystron amplifier.</li> <li>- Developed a more rigorous physical foundation for modeling the effects of RF radiation on radar and RF sensor systems.</li> </ul> </li> </ul> <p>Total 2433</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2558 - Model physical phenomena and incorporate into electronic warfare analysis simulation tools for radar and RF sensors.               <ul style="list-style-type: none"> <li>- Develop electromagnetic susceptibility assessment tools and methods and conduct HPM susceptibility assessments (through experimentation and analyses) of foreign and US Army assets including munitions, communications equipment and avionics to support ATDs and ACTDs.</li> <li>- 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-optics and millimeter wave limiters.</li> <li>- 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.</li> </ul> </li> <li>38 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2596</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project A140  |                   |                     | Page 10 of 11 Pages |   |                     |                     | Exhibit R-2 (PE 0602120A) |                              |                     |            |

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|--|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602120A Sensors and Electronic Survivability</b> | PROJECT<br><b>A140</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2770 -Develop and enhance current susceptibility tools and measurement methodologies that can be implemented to perform high power radio frequency (HPRF), HPM, and electromagnetic environment (EME) susceptibility assessments on US and foreign assets.</li> <li>-Investigate and characterize new wideband gap semiconductor materials for high-power/high-field applications, specifically focusing on MMIC compatible protection circuits, that will lead to the development and implementation of RF and EM hardened devices for critical systems of the electronic battlefield.</li> <li>-Begin the design of high average power traveling wave tubes and advanced radio frequency-directed energy weapons (RF-DEW) pulsers. Continue design of high average power, broadband klystron components.</li> <li>-Formulate and model first-principle deceptive countermeasure (CM) techniques against anti-radiation missile (ARM) threat.</li> </ul> <p>Total 2770</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3014 -Continue to investigate and characterize new wideband gap semiconductor materials for high-power/high-field applications, specifically focusing on large dynamic range limiters extending into MMW spectrum, that will eventually lead to the development and implementation of RF and EM hardened devices for critical systems on the electronic battlefield.</li> <li>-Study and model generic techniques for mitigating upset of electronic systems and equipment.</li> <li>-Complete a design of high average power broadband klystron amplifier and report on the possibilities for size and weight reduction of continuous wave (CW) broadband klystron amplifiers and begin preliminary design of a high-power ultra wideband source.</li> <li>-Incorporate and validate deceptive CM technique models in ARM simulation environment.</li> </ul> <p>Total 3014</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2496</td> <td style="text-align: center;">2651</td> <td style="text-align: center;">2782</td> <td style="text-align: center;">2977</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2565</td> <td style="text-align: center;">2596</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-132</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2433</td> <td style="text-align: center;">2596</td> <td style="text-align: center;">2770</td> <td style="text-align: center;">3014</td> </tr> </tbody> </table> |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2496 | 2651 | 2782 | 2977 | Appropriated Value | 2565 | 2596 |  |  | Adjustments to Appropriated Value | -132 |  |  |  | FY 1998 Pres Bud Request | 2433 | 2596 | 2770 | 3014 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 2496  | 2651                         | 2782           | 2977           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 2565  | 2596                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -132  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 2433  | 2596                         | 2770           | 3014           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project A140   | Page 11 of 11 Pages   | Exhibit R-2 (PE 0602120A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602211A Aviation Technology</b> |                     |                           |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 17853             | 21898               | 25982               | 30281   | 30249               | 31911                     | 33020               | 33737                        | Continuing          | Continuing |
| A47A Aeronautical and Aircraft Weapons Technology  | 15340             | 19213               | 23110               | 27152   | 27132               | 28605                     | 29712               | 30374                        | Continuing          | Continuing |
| A47B Vehicle Propulsion and Structures Technology  | 2513              | 2685                | 2872                | 3129  | 3117                | 3306                      | 3308                | 3363                         | Continuing          | Continuing |
| <p><b>Mission Description and Budget Item Justification :</b> 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, 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, and aircraft weapons. The work in this PE is consistent with the Department of Defense Technology Area Plans, DoD Joint Warfighter Science and Technology Master Plan , DoD Project Reliance agreements (for which the Army is the lead service for the development of rotorcraft), the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and a coordinated, national rotary-wing technology plan. This PE also supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry and academia, whose primary objective is to ensure the continued superiority of U.S. military rotorcraft systems through focused technology projects with a near term (2-3 year) return on investment, enabling rapid technology insertion into military and commercial rotorcraft. The Army and NASA provide funding which is matched by industry. Army, NASA, Navy, and Federal Aviation Administration (FAA) provide staffing and support for NRTC operations. Projects in this PE include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.</p> <p>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 Engines, Phoenix, AZ; Sikorsky, Stratford, CT; Rolls Royce, Indianapolis, IN; Kaman Aerospace Corp., Bloomfield, CT; Pratt &amp; Whitney, CT; and United Technologies Research Center, CT. Additionally, work in this PE is performed by universities including Arizona State University, AZ; Georgia Institute of Technology, GA; Ohio State University, OH; Penn State University, PA; Purdue University, IN; Texas A&amp;M, TX; University of Southern California, CA; University of Florida, FL; University of Illinois, Il; University of Maryland, MD; University of Michigan, MI; University of Utah, UT; Virginia Polytechnic Institute and State University, VA and Wichita State University, KS.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b> |                              |
| <p>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 Technology Center (VTC) /Army Research Laboratory (ARL), NASA Langley Research Center, Hampton, VA; and Vehicle Technology Center/ARL, NASA Lewis Research Center, Cleveland, OH.</p> <p>This program adheres to Tri-Service Reliance Agreements on Aeropropulsion and Air Vehicles (Rotary) with oversight (the Army is designated the lead DoD agency for rotorcraft technology) 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 the 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; participation in the Joint Aeronautical Commander's Group, The Technical Cooperation Program (TTCP), NASA Research and Technology Committees, and the North Atlantic Treaty Organization (NATO) Advisory Group on Aerospace Research and Development (AGARD). Efforts under this PE transition 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 supported: The Tri-Service Integrated High Performance Turbine Engine Technology (IHPTET) program and Navy/Army Joint Advanced Health and Usage Monitoring System (JAHUMS) 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.</p> |  |                              |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b> |                     |                           |                     | PROJECT<br><b>A47A</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A47A Aeronautical and Aircraft Weapons Technology  | 15340             | 19213               | 23110               | 27152  | 27132               | 28605                     | 29712               | 30374                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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-ground and air-to-air combat, increased strategic and tactical mobility, improved fire power, increased reliability and reduced maintenance, and increased combat sustainability. Work in this project maintains world excellence in rotorcraft technology through the study of advanced technologies and their applications to rotorcraft. Areas of investigation and research consist of the following: fluid mechanics, dynamics, aerodynamics, advanced flight control technology, handling qualities, aircraft 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. This project also supports work done under the auspices of the National Rotorcraft Technology Center (NRTC). NRTC addresses five critical path military/civil rotorcraft technology thrusts as follows: (a) process and product improvement for affordability, quality and environmental compliance; (b) enhanced rotorcraft performance; (c) passenger and community acceptance; (d) expanded rotorcraft operations; (e) technologies to support harmonized military qualification. and civil certification.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 9943 -Initiated rotorcraft integration analysis of Air to Air weapons and Low Cost Precision Kill (LCPK); updated simulations/models for non-lethal weapons (NLW).<br/>                     -Completed integrated flight and fire control (IFFC) design for hardware/pilot-in-the-loop simulation/ flight test demonstrations; continued slung load cargo handling qualities development; applied control limiting for cueing to achieve carefree maneuvering; initiated demonstration of full integrated flight and fire control (IFFC) in ground based systems integration facility; initiated integration/checkout of Rotorcraft-Aircrew Systems Concepts Airborne Laboratory (RASCAL) research flight control system; combined innovative rotor technologies and integrated aeromechanics analysis; merged interdisciplinary tools to set design direction for Helicopter Active Control Technology (HACT) demonstration (supports Joint Transport Rotorcraft (JTR) Program).<br/>                     -Cooperated, under the auspices of the NRTC, with US rotorcraft industry, NASA, Navy, FAA, and academia to reduce manufacturing and operating costs, and evolve critical technologies for exploitation of military and civil rotary-wing applications.</li> </ul> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| Project A47A   |                   |                     | Page 3 of 9 Pages   |  |                     | Exhibit R-2 (PE 0602211A) |                     |                              |                     |            |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b> | PROJECT<br><b>A47A</b>   |
| <p>-Initiated a system to measure and control the cure state of a composite laminate; initiated advanced joining technology for fabrication of large, complex structural assemblies in a single cure/ bond cycle; initiated crash dynamics modeling and simulation effort jointly with Army Research Lab (ARL) / Vehicle Structures Directorate (VSD); completed two dynamic impact (drop) tests of crashworthy thermoplastic subfloor sections; completed field evaluation of crashworthy aviator seatback cushions.</p> |  |  |
| <b>FY 1996 Accomplishments (continued)</b>  |  |  |
| •   | 5397   | <p>-Conducted spin test of low inertia turbine to IHPTET Phase II conditions; completed design of Army/Air Force centrifugal compressor; tested Army/ Air Force non-intrusive ignition system, and tested organic matrix composite engine inlet housing; conducted reliability and maintainability sensitivity assessments to identify high priority reliability, maintainability and cost drivers.</p> <p>-Completed program to assess Low Observable (LO) material durability; validated Visual Electro-Optical (VISEO) models.</p> <p>-Continued analysis and concept development of advanced manned and unmanned VTOL systems, working as teams.</p> <p>-Added model of auditory communications to Man-machine Design and Analysis System (MIDAS), and implemented new user interface and single language simulation.</p> <p>-Provided payment for services from the Defense Finance Accounting System (DFAS).</p>   |
| Total   | 15340  |  |
| <b>FY 1997 Planned Program:</b>   |  |  |
| •   | 11830  | <p>-Continue air-to-air integration studies, LCPK integration concept and investigate integration concepts of NLW for rotorcraft studies.</p> <p>-Provide handling qualities criteria for cargo class rotorcraft slung load night operations; demonstrate carefree maneuvering using control limiting/cueing/applying neural nets; conduct hardware/software design validation for IFFC; complete RASCAL research flight control system checkout and initiate flight simulations; develop critical aeromechanics models for low-cost rotor/fuselage systems.</p> <p>-Demonstrate advanced joining methodologies for scaled composite structures; demonstrate close-loop composite cure process control; develop regime recognition algorithms for structural usage spectrum; initiate effort to demonstrate lightweight, crashworthy landing gear components through the use of metal matrix composite materials; initiate program to demonstrate Z-Pin technology on primary airframe structure; refine crashworthiness simulation codes for Army helicopter application and conduct component-level validation tests.</p> <p>-Conduct engine test of low inertia turbine; fabricate components and assemble into test rig Army/Air Force high pressure ratio centrifugal compressor; demonstrate Army/Air Force non-intrusive ignition system; initiate high performance, light weight turbine module program; initiate efforts in acoustic fault detection and testing of inductive oil monitoring sensors.</p> |
| •   | 6465   | <p>-Perform an analytical study of advanced visual/EO camouflage effectiveness; initiate program to develop RF transparent rotor blade leading edge erosion protection system; initiate program to develop advanced, light weight, low cost thermal insulation; initiate a program to develop a multi-spectral database of VISEO terrain backgrounds.</p> <p>-Begin comprehensive formal workstation evaluation of MIDAS.</p>  |
| <p>Project A47A <span style="float:right">Page 4 of 9 Pages</span> <span style="float:right">Exhibit R-2 (PE 0602211A)</span></p>   |  |  |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b>   | PROJECT<br><b>A47A</b>       |
|  | -Develop cooperatively, under the auspices of the NRTC, technologies in the areas of low cost and efficient composite structures, reduced manufacturing and operating costs, active flight controls, increased reliability and flight safety, enhanced vehicle performance, noise and vibration reduction, and advanced drivetrain design.   |                              |
| 918  | -Provide payment for services from the DFAS.   |                              |
| Total 19213  |  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 4629   | -Continue NRTC cooperative technology development in low cost and efficient composite structures, metal processing, active flight control and handling qualities, reliability and flight safety, vehicle performance, vibration, acoustic signature, manufacturing and maintenance costs, drivetrains and environmental compliance.  |                              |
| • 7926   | -Continue LCPK, NLW and Rotorcraft Air Combat Enhancement (RACE) integration studies; perform coupon tests of advanced multi-spectral pigments, flight test enhanced camouflage coatings; improve crashworthiness codes via modeling and component tests; perform component trade studies for large rotorcraft crashworthiness criteria and component test for acoustic fault detection; continue program to develop advanced, light weight, low cost thermal insulation; initiate fuzzy logic applied diagnostics for sub-systems technology for affordability and sustainability. -Substantiate accuracy of improved algorithms for analysis of data from structural monitoring; initiate program to demonstrate adaptive tooling for complex composite structures; fabricate metal matrix landing gear components; select material and initiate component design for high temperature composites; support fabrication of Z-pin reinforced primary airframe structure; continue structural crash dynamic modeling and simulation effort. |                              |
| • 9637   | -Design, fabricate and hover test an on-blade control concept on a model scale rotor in support of the Advanced Rotorcraft Aeromechanics Technology; complete aeronautical design standard on helmet modeled display symbology; complete Beta release of MIDAS to add second generation cognitive models and improvement of execution speed; complete RASCAL flight control system integration and check out; explore advanced tri-service rotorcraft concepts for cargo systems. -Design/develop lightweight high efficiency turbine component for IHPTET Phase III; initiate high performance centrifugal compressor design and conduct assessment of advanced gear materials.   |                              |
| • 918  | -Provide payment for services from the DFAS.   |                              |
| Total 23110  |  |                              |
| <b>FY 1999 Planned Program:</b>                                |  |                              |
| • 7076   | -Continue NRTC cooperative technology development in the area of active flight controls, and to reduce manufacturing and operating costs, increase reliability and flight safety, and expand rotorcraft operating capabilities.  |                              |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b> | PROJECT<br><b>A47A</b>       |
| <ul style="list-style-type: none"> <li>• 8830 -Continue LCPK, NLW and RACE integration studies; conduct coupon test of advanced multi-spectral pigment/binder systems, fabricate and test subscale IR suppressor concepts; perform structural modeling and full scale crash test of Advanced Composite Airframe Program (ACAP); complete crashworthiness system optimization and design methodology for large rotorcraft; complete algorithm validation and demonstrate detection of impending dynamic mechanical failures; complete analysis of multiple fault systems, establish impact of fuzzy logic methods as a diagnostic tool and initiate development of an advanced full flow debris sensor to monitor oil born debris in lubricated mechanical systems.<br/>-Conduct test of metal matrix landing gear components; complete detail design and fabricate ballistic tolerant stiffener component using advanced techniques; fabricate high temperature composite component and conduct test; validate composite structural joint methodology; provide validated strength and fatigue life methodologies for rotorcraft composite structures.</li> </ul> <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 10328 -Conduct test of on-blade control concept in forward flight on a Mach-scaled rotor; complete formal evaluation of embedded model accuracy and transition MIDAS to industry through Army/NASA vehicle applications and cooperative research and development agreements; develop stability concepts for external loads and high speed forward flight; flight validate carefree maneuvering concepts in RASCAL; conduct analysis and evaluations on tri-service rotary-wing future system concepts.<br/>-Fabricate and conduct component test of lightweight turbine and complete design and fabrication of centrifugal compressor; initiate composite shaft program and test advanced hot, high hardness gear candidate designs.</li> <li>• 918 -Provide payment for services from the DFAS.</li> </ul> <p>Total 27152</p> |  |                              |
| <b>B. Project Change Summary</b>  |  |                              |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               |
| FY 1997 President's Budget  | 15393  | 21940                        |
| Appropriated Value  | 15821  | 19213                        |
| Adjustments to Appropriated Value   | -481   |                              |
| FY 1998 Pres Bud Request  | 15340  | 19213                        |
|   |  | <u>FY 1998</u>               |
|   |  | 24994                        |
|   |  | <u>FY 1999</u>               |
|   |  | 27305                        |
|   |  | 23110                        |
|   |  | 27152                        |
| Change Summary Explanation: Funding: FY 1997 - Congressional reduction (-2727).   |  |                              |
| Project A47A  |  |                              |

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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b> |                     |                           |                     | PROJECT<br><b>A47B</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A47B Vehicle Propulsion and Structures Technology   | 2513              | 2685                | 2872                | 3129   | 3117                | 3306                      | 3308                | 3363                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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; and aeroelastic interactions. 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1398 -Completed testing of splintered rotor demonstrating ultra-high pressure ratio (greater than 3:1) from single axial compressor stage.<br/>-Coupled wave rotor unit with electric heater to simulate engine configuration which is expected to achieve significant increases in power and reductions in fuel consumption; conducted analysis of engine system with wave rotor.<br/>-Completed test rig fabrication for demonstration of high temperature magnetic bearing.</li> <li>• 1115 -Tested ARES II system in Transonic Dynamic Tunnel (TDT) calibration laboratory, and initiated redesign to correct deficiencies; completed wind tunnel studies using the tiltrotor model for: 1) a composite tailored wing designed to augment aeroelastic stability, and 2) an active swashplate and flaperon for vibration reduction.<br/>- Prepared the Beechcraft Starship aircraft fuselage for ground vibration test (GVT) and model analysis for future interior noise control evaluations; reduced interior noise data from XV-15 flight test data and compared with initial analytical predictions from NASA acoustics code.<br/>- Completed parametric studies on frame-to-skin debond strength for bonded fuselage structures; conducted quasi-static indentation tests on graphite missile tubes to obtain damage characterization data and verified results using non-destructive evaluation (NDE) methods; awarded patent on "Method and Apparatus for Thermographically and Quantitatively Analyzing a Structure for Disbonds and/or Inclusions."<br/>- Validated thermal NDE method for measuring fiber volume fraction; completed predesign analysis of lightweight low cost tiltrotor thin wing; conducted static tests of advanced structural concept for engine/pylon attachment at a tiltrotor wing tip; developed new 2D to 3D transition element for analyzing local thickness effects in composite shell structures.</li> </ul> <p>Total 2513</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1545 -Complete wave rotor warm cycle experimental program and wave rotor/gas turbine engine integration analysis.<br/>-Complete ceramic matrix composite turbine nozzle hardware fabrication and component testing for IHPTET III.</li> </ul> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b>  | PROJECT<br><b>A47B</b>       |
| <b>FY 1997 Planned Program: (continued)</b>                    |   |                              |
|  | <ul style="list-style-type: none"> <li>-Complete demonstration of 5:1 compression ratio in two axial stages for use by the Joint Turbine Advanced Gas Generator (JTAGG II).</li> <li>-Complete face gear transmission component level experimental and analytical evaluation.</li> <li>-Validate engine dynamic model and concepts for active compressor stability enhancement.</li> </ul>  |                              |
| • 1140   | <ul style="list-style-type: none"> <li>- Participate in Transonic Dynamics Tunnel calibration with equipment design and fabrication, and test section calibration; complete reassign of ARES II platform, fabricate required parts, and conduct bench and hover tests; construct new tiltrotor hover test facility, and conduct initial hover test of the refurbished transmission system on the WRATS tiltrotor model.</li> <li>- Determine structural and flight loading requirements for an innovative composite fuselage concept for improved crashworthiness; refine XV-15 exterior acoustic source pressure predictions to improve correlation's with surface pressure measurements; conduct structural dynamic ground vibration tests of a composite aircraft fuselage for model properties and compare with NASTRAN model predictions in preparation for interior noise control studies.</li> <li>- Conduct fatigue tests on riveted test coupons to assess crack growth rate and total fatigue life of riveted structures; implement 2D to 3D transition element into advanced shell finite element (FE) code; investigate potential for rapid inspection of composites by combining different NDE technologies through data fusion.</li> <li>- Conduct strength and stiffness tests of tailored composite panels and correlate with finite element analysis; fabricate calibrated bond test coupons to investigate adhesive cracking caused by microstructure defects.</li> </ul> |                              |
| Total  | 2685  |                              |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| • 1653   | <ul style="list-style-type: none"> <li>-Complete laser velocimetry mapping of splintered rotor compressor stage.</li> <li>-Characterize wave rotor start up process and develop wave rotor operating map.</li> <li>-Conduct aero and heat transfer tests at off design conditions for advanced transonic blading.</li> <li>-Complete seed fault diagnostic/prognostic spiral bevel gear tests.</li> <li>-Demonstrate expert system controller for high temperature magnetic bearing.</li> </ul>   |                              |
| • 1219   | <ul style="list-style-type: none"> <li>- Determine potential for increasing inherent lag damping in rotorsystems using elastic couplings; Perform aeroelastic tailoring study for soft-inplane tiltrotor design, fabricate a parametrically variable soft-inplane hub for the WRATS tiltrotor model, and perform hover test.</li> <li>- Assemble a general purpose active control system for testing generic sets of actuator/controllers and aggressive closed-loop control laws.</li> <li>- Fabricate the innovative composite fuselage specimens and verify under simulated crash test conditions that they meet crashworthiness criteria; conduct interior noise control studies of a composite aircraft fuselage.</li> <li>- Conduct fatigue tests on structural panels to validate fatigue life and crack growth rates of actual riveted aircraft structures.</li> <li>- Develop FE model based on solid-to-shell transition elements for debond analysis of stitched interface.</li> <li>- Develop NDE data fusion software using probability based criteria for combining different methods to classify defects; validate durability and damage tolerance models for composite structures; evaluate NDE methods to measure strength of bonded structures.</li> </ul>  |                              |
| Total  | 2872  |                              |
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|---|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|---------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602211A Aviation Technology</b> | PROJECT<br><b>A47B</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1800 -Couple wave rotor with combustor at engine conditions.             <ul style="list-style-type: none"> <li>-Demonstrate readiness of micro, electrical, mechanical systems (MEMS) technology for application to engine components.</li> <li>-Complete analysis and performance testing of advanced compressor stage for JTAGG III.</li> <li>-Conduct validation tests on thermal behavior of high speed gearing.</li> <li>-Conduct high temperature rig testing of magnetic bearing system for JTAGG III.</li> </ul> </li> <li>• 1329 -Complete aeroelastic tiltrotor model test of an aggressive active control system for vibration reductions during simulated maneuvers; initiate fabrication of a new low-noise tiltrotor blade and hub loads versus conventional stiff-inplane hub; validate the scaled innovative composite fuselage concept for improved crashworthiness technology through fabrication and testing of a full-scale prototype fuselage.             <ul style="list-style-type: none"> <li>- Validate fracture mechanics models for predicting crack link-up in riveted aircraft structures; validate strength and fatigue life methods for composite structures; develop prototype remote system and specifications to measure bond strength and test on adhesively bonded structures; evaluate NDE data fusion methodology using field measurements.</li> <li>- Initiate adaptive architecture methodology to automate 2D to 3D transition in nonlinear structural analysis.</li> </ul> </li> </ul> <p>Total            3129</p> |  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 15%; text-align: center;"><u>FY 1996</u></th> <th style="width: 15%; text-align: center;"><u>FY 1997</u></th> <th style="width: 15%; text-align: center;"><u>FY 1998</u></th> <th style="width: 15%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2577</td> <td style="text-align: center;">2743</td> <td style="text-align: center;">2858</td> <td style="text-align: center;">3110</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2649</td> <td style="text-align: center;">2685</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-136</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Budget</td> <td style="text-align: center;">2513</td> <td style="text-align: center;">2685</td> <td style="text-align: center;">2872</td> <td style="text-align: center;">3129</td> </tr> </tbody> </table>  |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2577 | 2743 | 2858 | 3110 | Appropriated Value | 2649 | 2685 |  |  | Adjustments to Appropriated Value | -136 |  |  |  | FY 1998 Pres Budget | 2513 | 2685 | 2872 | 3129 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |
| FY 1997 President's Budget  | 2577   | 2743                         | 2858           | 3110           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |
| Appropriated Value  | 2649   | 2685                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |
| Adjustments to Appropriated Value   | -136   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |
| FY 1998 Pres Budget   | 2513   | 2685                         | 2872           | 3129           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |
| Project A47B  | Page 9 of 9 Pages  | Exhibit R-2 (PE 0602211A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                     |      |      |      |      |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602270A Electronic Warfare (EW) Technology</b> |                     |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost   | 14651             | 15510               | 16528               | 18151  | 18088               | 18735               | 19128               | 19549                        | Continuing          | Continuing |
| A442 Tactical Electronic Warfare Technology   | 8907              | 8599                | 9155                | 9957   | 9922                | 10275               | 10489               | 10724                        | Continuing          | Continuing |
| A906 Tactical Electronic Warfare Techniques   | 5744              | 6911                | 7373                | 8194   | 8166                | 8460                | 8639                | 8825                         | Continuing          | Continuing |
| <p><b><u>Mission Description and Budget Item Justification</u></b> : This program investigates electronic warfare (EW) technologies for current and future systems. The efforts in EW will enable the Army to deny the enemy use of the radio spectrum for command, control, communications and computer intelligence purposes, and provide a decisive advantage to our operational forces against the full range of traditional and non-traditional threat forces. Electronic countermeasures and self protection developments will protect Army forces from a broad range of radio frequency (RF) surveillance/tracking systems and advanced RF/ electro-optical infrared (EOIR) missiles and smart munitions. It also includes 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 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. 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 and Communications (C3) Technology), PE 0602709A (Night Vision and Electro-Optics Technology), PE 0603789F (C3 Intelligence Technology Development), PE 0603270A (Electronic Warfare Technology), PE 0604270A (Electronic Warfare Development), and PE 0603745A (Tactical Electronic Support Systems - Advanced Development) in accordance with the ongoing Reliance joint planning process. This program is primarily managed by Communications-Electronics Research, Development and Engineering Center (CERDEC), Fort Monmouth, NJ.</p> |                   |                     |                     |  |                     |                     |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602270A Electronic Warfare (EW) Technology</b> |                     |                     |                     | PROJECT<br><b>A442</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A442 Tactical Electronic Warfare Technology   | 8907              | 8599                | 9155                | 9957  | 9922                | 10275               | 10489               | 10724                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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:</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- 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.</li> <li>- Laser warning and countermeasures - technologies that provide air and ground platforms with warning and jamming capability against laser-aided and electro-optically-directed threats including laser range finders, laser designators and laser beamrider missiles.</li> <li>- 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.</li> <li>- Area protection radar countermeasures - technologies that provide radar stand-off and stand-in jamming and deception in support of ground forces.</li> </ul> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3050 - Demonstrated radio frequency (RF) sensor and electronic attack (EA) modulator with capability to locate, deceive and jam monopulse and phased array radars from UHF through millimeter wave; initiated development of low cost finger-printing for signal sorting and combat identification (ID) assistance.               <ul style="list-style-type: none"> <li>- Conducted experiments to pass threat data derived from electronic warfare (EW) self-protection systems to ground vehicles and command posts.</li> </ul> </li> <li>• 3601 - Demonstrated missile warning sensor for low observable (LO) platforms; developed gimbal-less beam steering; developed CM to advanced electro-optic-infrared (EOIR) missiles using advanced special seekers.</li> <li>• 2256 - Completed the design of the ES/super high frequency (SHF) receiver and demonstrated the advantages over current receivers.               <ul style="list-style-type: none"> <li>- Initiated the design of an ES signal processor to provide optimal exploitation of radar signals of interest.</li> <li>- Initiated fabrication of the omni-directional, high gain, multi-band antenna.</li> <li>- Continued program for advanced countermeasures against advanced special radar systems.</li> <li>- Continued efforts to target non-conventional sensors to develop "surgical" countermeasures techniques.</li> </ul> </li> </ul> <p>Total 8907</p> |                   |                     |                     |   |                     |                     |                     |                              |                     |            |
| Project A442  |                   |                     |                     | Page 2 of 7 Pages   |                     |                     |                     | Exhibit R-2 (PE 0602270A)    |                     |            |

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|--|---|------------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602270A Electronic Warfare (EW) Technology</b>   | PROJECT<br><b>A442</b>       |
| <b>FY 1997 Planned Program:</b>  |   |                              |
| <ul style="list-style-type: none"> <li>• 3043</li> <li>• 3327</li> <li>• 2161</li> <li>• 68</li> <li>Total 8599</li> </ul> | <ul style="list-style-type: none"> <li>- 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.</li> <li>- Develop fiber optic components to remote aircraft and ground vehicle RF antennas and jamming modules as potential upgrades to current EW systems that will increase warning receiver sensitivity, increase jamming signal to noise ratios, improve reliability, and decrease weight.; initiate development of high direction of arrival accuracy laser warning receiver; and conduct tests against advanced phase array radar.</li> <li>- Exploit advanced EOIR CM against advanced threat missiles (surface-to-air missiles (SAMs) and anti-tank missiles); techniques will be demonstrated in multi-spectral countermeasures technology demonstration (PE 0603270A/DK16).</li> <li>- Complete the design of the ES signal processor and demonstrate its performance improvements over currently used processors.</li> <li>- Demonstrate the omni-directional, high-gain, multiband antenna with the next generation ES/SHF receiver.</li> <li>- Implement initiative to develop countermeasures to exploit digital radars.</li> <li>- Continue program for advanced countermeasures against advanced special radar systems.</li> <li>- Demonstrate efforts to target non-conventional sensors to develop "surgical" countermeasures techniques.</li> <li>- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> |                              |
| <b>FY 1998 Planned Program:</b>  |   |                              |
| <ul style="list-style-type: none"> <li>• 3087</li> <li>• 3780</li> <li>• 2288</li> <li>Total 9155</li> </ul>               | <ul style="list-style-type: none"> <li>- Test low cost finger-printing for signal sorting and targeting assist in the Survivability Integration Laboratory (SIL) and link to Ft. Rucker's aviation testbed for user experiment; complete phased array radar digital model to support ECM development.</li> <li>- Initiate development of multispectral sensor for RF and missile warning as a single module that can form, fit and function replace multiple sensors on aircraft and ground vehicles; complete the tri-service work on the digital advanced special IR missile to support the multispectral countermeasures demonstration.</li> <li>- Continue laboratory demonstrations for the low probability of intercept (LPI) appliqué receiver and the high speed impulse detector to enable common module electronics intelligence system (CMES) to perform rapid detection, characterization and direction finding of low-power impulse emitters.</li> <li>- Develop test platform for analysis of efforts to ensure compliance with Joint Airborne SIGINT Architecture (JASA) standards.</li> <li>- Develop a simulation tool for the analysis and effectiveness of technology insertion candidate projects.</li> <li>- Initiate countermortar counterbattery radar countermeasures program.</li> <li>- Perform laboratory demonstration of advanced special radar systems countermeasures.</li> </ul>  |                              |
| Project A442   | Page 3 of 7 Pages   | Exhibit R-2 (PE 0602270A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
|--|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|-------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602270A Electronic Warfare (EW) Technology</b> | PROJECT<br><b>A442</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3386 - Complete development of the fiber optic remote antenna assembly; integrate into PM-Aviation Electronic Combat (AEC) suite of integrated RF countermeasures testbed for SIL and flight tests. Transition to the Integrated Situation and Countermeasures (ISACM) demonstration.             <ul style="list-style-type: none"> <li>- Complete precision UHF/MMW precision direction finding, conduct SIL and flight tests, and transition to ISACM; continue development of jamming techniques against bi-static, low probability of intercept (LPI) and impulse radars.</li> </ul> </li> <li>• 4082 - Continue multispectral RF and laser warning sensor development; initiate jamming effects ECM against integrated multispectral IR missiles, top attack munitions and advanced anti tank guided missiles (ATGMs); complete development of high direction of arrival accuracy laser warning receiver and conduct test.</li> <li>• 2489 - Conduct laboratory demonstrations for the Multiple Spread Spectrum Subreceiver and the Adaptive Matched Filter Receiver to improve the capability of CMES to detect/characterize modern signals in the presence of a heavy conventional signal environment.             <ul style="list-style-type: none"> <li>- Continue development of the JASA compliant test platform.</li> <li>- Continue countermortar counterbattery radar countermeasures effort.</li> <li>- Demonstrate the advanced special countermeasures prototype in the field.</li> </ul> </li> </ul> <p>Total            9957</p> |   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9023</td> <td style="text-align: center;">8783</td> <td style="text-align: center;">9078</td> <td style="text-align: center;">9498</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">9274</td> <td style="text-align: center;">8599</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-367</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">8907</td> <td style="text-align: center;">8599</td> <td style="text-align: center;">9155</td> <td style="text-align: center;">9957</td> </tr> </tbody> </table>   |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9023 | 8783 | 9078 | 9498 | Appropriated Value | 9274 | 8599 |  |  | Adjustments to Appropriated Value | -367 |  |  |  | FY1998 Pres Bud Request | 8907 | 8599 | 9155 | 9957 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| FY 1997 President's Budget   | 9023  | 8783                         | 9078           | 9498           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| Appropriated Value   | 9274  | 8599                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| Adjustments to Appropriated Value  | -367  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| FY1998 Pres Bud Request  | 8907  | 8599                         | 9155           | 9957           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |
| <p>Project A442 <span style="float: right;">Page 4 of 7 Pages      Exhibit R-2 (PE 0602270A)</span></p>  |   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602270A Electronic Warfare (EW) Technology</b> |                     |                           |                     | PROJECT<br><b>A906</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A906 Tactical Electronic Warfare Techniques   | 5744              | 6911                | 7373                | 8194  | 8166                | 8460                      | 8639                | 8825                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This applied research program involves technologies that provide the capability to intercept, direction find (DF) and locate current and emerging threat communications emitters for targeting, tactical situation awareness, and disruption/destruction of enemy command, control and communications (C3) systems. It specifically develops essential electronic attack (EA) components and techniques for advanced jammers and smaller, low power, lightweight, common modules for advanced systems to counter communications associated with modern threat C3 systems. In addition, it will provide the capability to update through remote means the intelligence and electronic warfare common sensor system (IEWCS) with EA algorithms that allow the system to disrupt, deny or destroy threat communication signals. This effort establishes 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2650 – Continued fabrication of HF antenna technology demonstrator and transformer utilizing high temperature superconducting (HTSC) materials and test functionality .             <ul style="list-style-type: none"> <li>– Continued analysis of diverse antenna applications against platform requirements for optimization purposes.</li> <li>– Completed vulnerability assessment of communication radio systems with several complex communication formats.</li> <li>– Acquired, analyzed and exploited modern tactical communications systems to develop EA strategies and update IEWCS threat system database.</li> </ul> </li> <li>• 3094 – Completed development of the efficient wideband receiver with the final breadboard configuration of the fast Fourier Transform (FFT) application specific integrated circuit (ASIC) utilizing quadratic residue number system (QRNS).             <ul style="list-style-type: none"> <li>– Completed development of initial battle damage assessment tools and techniques.</li> <li>– Completed initial capability for effectively tasking and receiving multi-intelligence sensor data.</li> <li>– Completed electronic intelligence (ELINT) portion of sensor asset management.</li> <li>– Completed initial terrain reasoning algorithms.</li> </ul> </li> <li>• – Completed initial prototype of correlation and templating tool.             <ul style="list-style-type: none"> <li>– Continued development of advanced terrain reasoning algorithms.</li> </ul> </li> </ul> <p>Total 5744</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |
| Project A906  |                   |                     | Page 5 of 7 Pages   |   |                     | Exhibit R-2 (PE 0602270A) |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)</b> |   | DATE<br><b>February 1997</b> |
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| BUDGET ACTIVITY  | PE NUMBER AND TITLE   | PROJECT                      |
| <b>2 - Applied Research</b>                                    | <b>0602270A Electronic Warfare (EW) Technology</b>  | <b>A906</b>                  |
| <b>FY 1997 Planned Program:</b>                                |   |                              |
| • 4200   | – Complete testing of HF antenna technology demonstrator and transformer.<br>– Acquire, analyze and exploit modern tactical communications systems to develop EA strategies and update IEWCS threat system database.<br>– Complete full military intelligence (MI) sensor asset management tools and techniques.<br>– Initiate examination of exploitation techniques for advanced communication networks.  |                              |
| • 2711   | – Complete tools and techniques for airborne asset management capability.<br>– Complete prototype of advanced terrain reasoning and generic tools for effectively tasking and receiving multi-intelligence sensor data.<br>– Continue smart agent tool for effectively tasking and receiving multi-intelligence sensor data.<br>– Investigate advanced communications jamming techniques to be utilized against evolving threat communications systems.   |                              |
| Total  | 6911  |                              |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| • 3920   | – Develop laboratory exploitation techniques against wideband commercial communication signals used for military purposes.<br>– Demonstrate laboratory exploitation capability against low power advanced communication system.<br>– Develop and test antenna systems supporting commercial communication exploitation effort.<br>– Initiate the breadboard development of a field programmable gate array (FPGA)-based signal analysis/attack control system (intended for IEWCS upgrade).   |                              |
| • 3453   | – Continue smart agent tools for effectively tasking and receiving multi-intelligence sensor data.<br>– Continue airborne asset management tools and techniques.<br>– Continue advanced terrain reasoning tools and techniques and development of SIGINT correlation, templating and associated terrain reasoning tools.<br>– Execute simulation project to asses incorporating information from airborne survivability equipment with conventional SIGINT assets.<br>– Begin prediction and assessment tools for electronic attack |                              |
| Total  | 7373  |                              |
| <b>FY 1999 Planned Program:</b>                                |   |                              |
| • 4928   | – Port attack algorithms against modern communication signals to the FPGA-based signals analysis control system.<br>– Initiate countermeasure analysis from a network perspective.  |                              |
| • 3266   | – Complete airborne asset management tools and techniques.<br>– Complete advanced terrain reasoning tools and techniques.<br>– Continue SIGINT correlation, templating and associated terrain reasoning tools.<br>– Continue electronic attack assessment and prediction tools  |                              |
| Total  | 8194  |                              |
| Project A906   | <i>Page 6 of 7 Pages</i>  | Exhibit R-2 (PE 0602270A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |   | DATE<br><b>February 1997</b> |                |                |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602270A Electronic Warfare (EW) Technology</b> | PROJECT<br><b>A906</b>       |                |                |
| <br><b>B. <u>Project Change Summary</u></b>                    |   |                              |                |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget                                     | 5763  | 7062                         | 7175           | 8538           |
| Appropriated Value   | 6037  | 6911                         |                |                |
| Adjustments to Appropriated Value                              | -293  |                              |                |                |
| FY1998 Pres Bud Request  | 5744  | 6911                         | 7373           | 8194           |
|  |   |                              |                |                |
| Project A906   | Page 7 of 7 Pages   | Exhibit R-2 (PE 0602270A)    |                |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602303A Missile Technology</b> |                     |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost   | 17535             | 29144               | 21632               | 24002  | 24236               | 25360               | 26412               | 26993                        | Continuing          | Continuing |
| A205 Solid State Dye Lasers   | 0                 | 3916                | 0                   | 0  | 0                   | 0                   | 0                   | 0                            | 0                   | 3916       |
| A214 Missile Technology   | 17535             | 25228               | 21632               | 24002  | 24236               | 25360               | 26412               | 26993                        | Continuing          | Continuing |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> This exploratory development program element is designed to provide the Army with missile, rocket, and unmanned vehicle technology ready for insertion into operational systems 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 element is driven by U. S. Army Training and Doctrine Command (TRADOC) Battle Labs and mission area analyses of deficiencies in the areas of close combat, fire support, air defense, intelligence/electronic warfare, and the priorities set forth in the Army Science and Technology Master Plan. The program element is focused on technologies which enhance weapon system deployability, flexibility, lethality, survivability, and affordability. Work within the program is conducted through system simulation, virtual prototyping, concept synthesis, hardware development, and focused technology demonstrations. The work in this program element is consistent with the resource constrained Army Science and Technology Master Plan, the Army Modernization Plan and 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 Industry Research Centers), PE 0603313A (Missile and Rocket Advanced Technology), PE 0603654A (LOSAT Technology Demonstration), PE 0602782A (C<sup>3</sup> Technology), PE 0605601A (Army Test Ranges and Facilities) in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments. This program element 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.</p> |                   |                     |                     |  |                     |                     |                     |                              |                     |            |



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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602303A Missile Technology</b> |                     |                     |                     | PROJECT<br><b>A205</b>       |                     |            |
| COST <i>(In Thousands)</i>                                     | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A205 Solid State Dye Lasers                                    | 0                 | 3916                | 0                   | 0   | 0                   | 0                   | 0                   | 0                            | 0                   | 3916       |

**A. Mission Description and Justification:** Funds for this program were directed by Congress. This program leverages technologies developed under PE 0602307A/ Project A139 Laser Technology. Project A205 provides for the development of dye laser technologies appropriate to future directed energy weapons and the transfer of these technologies to medical applications. This project focuses on developing technologies related to the use of directed energy as a weapon against hardened targets, based on the fact that optical and radio frequency components are inherently vulnerable to laser radiation in their operating bands. 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 these various applications. The program's objectives center around development of compact, efficient pulsed devices with wavelength diversity and extended service life. This program is closely coordinated with the other services through the Joint Directors of Laboratories (JDL) Reliance Panel on Conventional Weapons. Work is performed by the U.S. Army Missile Command (MICOM) Research, Development, and Engineering Center, Redstone Arsenal, AL. Major contractors include Textron Defense Systems and Palomar Medical Systems.

**FY 1996 Accomplishments:** Project not funded in FY 96.

**FY 1997 Planned Program:**

- 1500 Develop and characterize solid host laser materials.
- 1400 Develop zig-zag laser with objective to demonstrate system operation.
- Integrate diffractive optic into zig-zag laser.
- 921 Evaluate solid host dye laser materials.
- Improve miniature blue laser.
- Investigate oscillator/amplifier utilizing solid host material.
- 95 Small Business Innovation Research/Small Business Technology Transfer Programs.

Total 3916

**FY 1998 Planned Program:** Project not funded in FY 98.

**FY 1999 Planned Program:** Project not funded in FY 99.

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b> | PE NUMBER AND TITLE<br><b>0602303A Missile Technology</b> | PROJECT<br><b>A205</b> |
|--|---|------------------------|

| <b>B. <u>Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|---|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget              | 0              | 0              | 0              | 0              |
| Appropriated Value                      | 0              | 3916           | 0              | 0              |
| Adjustments to Appropriated Value       | 0              |                | 0              | 0              |
| FY 1998 Pres Bud Request                | 0              | 3916           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997 - Funds added by Congress.

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602303A Missile Technology</b> |                     |                     |                           | PROJECT<br><b>A214</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A214 Missile Technology  | 17535             | 25228               | 21632               | 24002   | 24236               | 25360               | 26412                     | 26993                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification</u>:</b> Project A214 is focused on missile and rocket technologies that support high fire power/logistic support weight ratio concepts for the early entry forces, to address system concepts that enhance the survivability of launch systems, to provide greater effectiveness under adverse battlefield conditions, to increase kill probabilities against hard targets, and to provide powerful new simulation and virtual prototyping analysis tools. This project encompasses seven major areas: missile guidance systems; air defense target acquisition systems; multi-spectral missile seekers; high fidelity system level simulations; missile aerodynamics and structure; smart, stealthy, smokeless missile propulsion; and focused technology integration/demonstrations. As efforts in these technology areas mature, work is transitioned to PE 0603313A (Missile and Rocket Advanced Technology) to support demonstrations of capabilities for early entry forces in the Rapid Force Projection Initiative (RFPI), Future Missile Technology Integration (FMTI), and an advanced light weight hypervelocity missile.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 6197 - Missile guidance systems - Defined guidance and control (G&amp;C) package requirements for the Low Cost Precision Kill 2.75 inch guided rocket and completed preliminary design for two alternative guidance concepts.               <ul style="list-style-type: none"> <li>- Air defense target acquisition systems - Continued to explore and evaluate integrated air defense fire control target acquisition algorithms and multi-sensor suites. Evaluated active/passive target recognition algorithms.</li> <li>- Multi-spectral missile seekers - developed missile seeker wide field-of-regard search and hand off techniques compatible with autonomous target acquisition; tested seeker hardware.</li> <li>- High fidelity system level simulations - developed and demonstrated improved techniques for target signature for hardware-in-the-loop simulation; applied commercial technology to simulation processors and scene generators for low cost solutions.</li> </ul> </li> <li>• 11338 - Missile aerodynamics and structure - validated rotary wing aero-propulsion model; evaluated and selected advanced materials for structural modeling development; completed damage area versus miss distance assessment for warhead guidance fusing techniques to increase capabilities of air defense systems; validated current air target penetration equations for Countering Armor Protection Systems (CAPS) problems.               <ul style="list-style-type: none"> <li>- Smart, stealthy, smokeless missile propulsion - continued development of smart propulsion componentry technology for application to adaptable, multimission, light weight, survivable systems.</li> <li>- Focused technology integration/demonstrations - integrated multi-mode airframe technology (MAT) components into a multi-mode airframe for hardware-in-the-loop test; completed conversion and demonstrated advanced optical correlator for use in the infrared (IR) spectrum; completed heavyweight ramburner test of ducted rocket engine for Japan Cooperative Program.</li> </ul> </li> </ul> <p>Total 17535</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project A214   |                   |                     | Page 4 of 6 Pages   |   |                     |                     | Exhibit R-2 (PE 0602303A) |                              |                     |            |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602303A Missile Technology</b>   | PROJECT<br><b>A214</b>       |
| <b>FY 1997 Planned Program:</b>                                |   |                              |
| • 9628   | - 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.<br>- Air defense target acquisition systems - demonstrate advanced integrated 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 integrated missile systems.<br>- Multi-spectral missile seekers - demonstrate missile seeker search and hand-off techniques applicable to autonomous target acquisition.<br>- 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.<br>- 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. |                              |
| • 10667  | - 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.<br>- Focused technology integration/demonstrations - execute MAT flight demonstration; conduct ground testing of lightweight ducted rocket engine demonstration for Japan Cooperative Program.  |                              |
| • 4933   | - Conduct compact kinetic energy missile (CKEM) technology demonstration concept definition, missile subsystem trades, and initial critical demonstrations in propulsion and guidance and control.<br>- Demonstrate the ability of novel kinetic energy penetrators to defeat future explosive reactive armor technology anticipated for fielding in the 2010-2015 time frame on advanced threat tanks.   |                              |
| Total  | 25228   |                              |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| • 10367  | - Missile guidance systems - Demonstrate through a captive field test seeker/sensors, inertial instrumentation, controller characterizations, and launcher platform integration technologies for a low cost accurate control package for the 2.75" rocket, that will provide reduced cost per kill , minimized collateral damage and greatly increased number of stowed kills over the present fielded system. Complete IR polarimetry demonstrations. Develop fly-over-shoot-down imaging tracking algorithms.<br>- High fidelity system level simulations - Apply computational electromagnetic methods to the prediction of ground target vehicle signatures at millimeter radar frequencies, and develop improved methods of estimating air and ground target infrared signatures for hardware-in-the-loop.<br>- Missile aerodynamics and structure - Complete craft computational fluid dynamics development, complete grid fin methodology and data base. Design hypervelocity missile structures; demonstrate feasibility of composite airframes and structures.   |                              |
| • 11265  | - Smart, stealthy, smokeless missile propulsion - Develop reduced combustor length ducted rocket engine, flight test low cost boost/sustain turbojet, develop advanced oxidizer fuel gels for long range, survivable, multi-mission capabilities which reduce assets required.  |                              |
| Project A214   | Page 5 of 6 Pages   | Exhibit R-2 (PE 0602303A)    |

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|-------|-------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602303A Missile Technology</b> | <b>PROJECT</b><br><b>A214</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| <p><b>FY 1998 Planned Program: (continued)</b><br/>                 - Focused technology integration/demonstrations - Demonstrate a motor and propulsion concept of the compact kinetic energy missile technology. Conduct assessment and analysis of new missile technologies.</p> <p>Total        21632</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            11502 - Missile guidance systems - Complete signature tests for difficult targets and masked helicopters, assess tracker, automatic target recognition, and non-cooperative target recognition on wide spectrum realistic data sets and targets, which will develop acquisition technologies for defeating classes of targets which are difficult or impossible to defeat presently.<br/>                     - High fidelity system level simulations - Develop improved techniques for calculating simulation scenario background clutter for millimeter wave radar and infrared wavebands. Initiate signature model validation for these wavebands based on comparison of measured and predicted signature results.<br/>                     - Missile aerodynamics and structure - Perform control fin wind tunnel test. Fabricate, assemble, and test the design and integration of high performance electronics into small diameter missile assemblies; demonstrate advanced damping systems to protect sensitive sensors/electronics from hypervelocity shock and vibration.</li> <li>•            12500 - Smart, stealthy, smokeless missile propulsion - Demonstrate high performance, minimum signature solid propulsion, complete actuator and control integration and demonstrate pintle, and develop gel flightweight component - for long range, survivable, multi-mission capabilities which reduce assets required.<br/>                     - Focused technology integration/demonstrations - Conduct a flight demonstration of the compact hypervelocity missile technology. Conduct assessment and analysis of new missile technologies.</li> </ul> <p>Total        24002</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">17500</td> <td style="text-align: center;">20295</td> <td style="text-align: center;">23320</td> <td style="text-align: center;">25025</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">17985</td> <td style="text-align: center;">25228</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-450</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">17535</td> <td style="text-align: center;">25228</td> <td style="text-align: center;">21632</td> <td style="text-align: center;">24002</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997- Funding increased by Congress (+4933) for compact kinetic energy missile technology demonstration.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 17500 | 20295 | 23320 | 25025 | Appropriated Value | 17985 | 25228 |  |  | Adjustments to Appropriated Value | -450 |  |  |  | FY 1998 Pres Bud Request | 17535 | 25228 | 21632 | 24002 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| FY 1997 President's Budget   | 17500  | 20295                         | 23320          | 25025          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Appropriated Value   | 17985  | 25228                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Adjustments to Appropriated Value  | -450   |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| FY 1998 Pres Bud Request   | 17535  | 25228                         | 21632          | 24002          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Project A214   | Page 6 of 6 Pages  | Exhibit R-2 (PE 0602303A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602308A Modeling and Simulation Technology</b> |                     |                           |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 19466             | 20652               | 21059               | 24287  | 27512               | 26070                     | 19284               | 20895                        | Continuing          | Continuing |
| AC90 Distributed Interactive Simulation (DIS) Technology   | 7662              | 9298                | 9995                | 10849  | 10827               | 11210                     | 11439               | 11706                        | Continuing          | Continuing |
| AC99 Advanced Concepts & Technology II (ACT II)  | 11804             | 11354               | 11064               | 13438  | 16685               | 14860                     | 7845                | 9189                         | Continuing          | Continuing |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> Work in this program element (PE) advances development and use of modeling and simulation, including distributed interactive simulation (DIS), related to Army-specific experiments/demonstrations and industry participation at the U. S. Army Training and Doctrine Command (TRADOC) Battle Labs and the Army's Force XXI. It develops standards, architecture and interfaces essential to realizing the DoD/Army vision of creating a verified, validated and accredited synthetic "electronic battlefield" environment. The electronic battlefield is used to investigate and demonstrate new warfighting concepts including development of tactics, doctrine, training techniques, soldier support, systems and system upgrades. It directs and stimulates advances in those technologies required for real time interactive linking within and among constructive, virtual and live simulations. Work also supports planning and execution of the Advanced Concepts and Technology (ACT) II program, which demonstrates mature technologies for the Army's Battle Labs. ACT II provides a timely, low overhead mechanism for industry and academia to participate in the Army's Force XXI and TRADOC Battle Labs' warfighting demonstrations and experiments. Work is consistent with the Army Science and Technology Master Plan and the Army Modernization Plan. Efforts include non-system specific development efforts directed at specific military needs and are correctly placed in Budget Activity 2.</p> <p>Work is performed by the broadest range of the nation's industrial and academic communities. Contractors include: Natural Selection, La Jolla, CA; Morris Brown College, Atlanta, GA; Acusoft, Orlando, FL; Pathfinder Systems, Lakewood, CO; University of Central Florida, Institute for Simulation and Training, Orlando, FL; Veda Incorporated, Orlando, FL; Perceptronics, Inc., Woodland Hills, CA; Lockheed Martin, Orlando, FL. 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: Center for Photonics Research, Boston, MA; Chain Reactions, Inc., Gold River, CA; FFE International, Inc., Alexandria, VA; General Dynamics Land Systems, Tallahassee, FL; Harris Corporation, Rochester, NY; Hughes Missile Systems Company, Tucson, AZ; Lockheed Martin Electro-Optical Systems, Inc., Pomona, CA; Lockheed Martin Vought Systems Corporation, Dallas, TX; Lucent Technologies, Inc., McLeansville, NC; McDonnell Douglas Aerospace, Huntsville, AL; McDonnell Douglas Aerospace, Huntington Beach, CA; Mobile Datacom Corporation, Clarksburg, MD; Monterey Bay Corporation, Columbia, MD; Morris Brown College, CERT, Atlanta, GA; Mystech Associates, Falls Church, VA; Northrop Grumman Corporation, Baltimore, MD; Research Triangle Institute, Research Triangle Park, NC; Rolands &amp; Associates Corporation, Monterey, CA; Syracuse Research Corporation, Syracuse, NY.</p> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602308A Modeling and Simulation Technology</b> |                              |
| <p>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, Defense Advanced Research Projects Agency (DARPA), Defense Modeling and Simulation Office, TRADOC and DoD Project Reliance agreements on conventional air/surface weaponry, with oversight provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with efforts in PE 0604715A (Non-System Training Devices - Engineering Development). There is no duplication of effort within the Army or Department of Defense.</p> |   |                              |
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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |   |                   |                     | PE NUMBER AND TITLE<br><b>0602308A Modeling and Simulation Technology</b> |                     |                     |                     | PROJECT<br><b>AC90</b>    |                     |                     |            |
| COST (In Thousands)  |   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate   | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
| AC90   | Distributed Interactive Simulation (DIS) Technology | 7662              | 9298                | 9995  | 10849               | 10827               | 11210               | 11439                     | 11706               | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This program provides and demonstrates enabling technologies for advancing distributed interactive simulation (DIS) and high level architecture (HLA) in a synthetic environment necessary to support the Army's goal of exploiting modeling and simulation technology as a significant acquisition and training tool. Synthetic environments with virtual combined arms battlefield representation will permit evaluation of new system concepts, tactics and doctrine and test requirements with a warfighter-in-the-loop throughout the acquisition life cycle, reducing both cost and time incurred by the traditional approach. Focus areas include computer generated forces (CGF), simulation interface and linkage technologies, and complex data modeling and interchange.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3217 - Provided high level architecture prototype demonstrations of emerging "object model templates" and simulation support tools for pre, post and run time and continued to develop authoritative computer generated forces representations of humans and human behavior for individuals and groups including verification, validation and accreditation (VV&amp;A).</li> <li>• 2390 - Established a multi-site, distributed laboratory of networked virtual reality devices for integration of individual warriors into synthetic environments.</li> <li>• 2055 - Defined methods and approaches for determining multi-cast grouping strategies for distributed systems required for linking interactively among all classes of simulation.</li> </ul> <p>Total 7662</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 781 - Demonstrate increased realism in intelligent operational forces (OPFOR) modeling; develop algorithms for configurable CGF behavioral modeling.</li> <li>• 1800 - Demonstrate an initial capability to provide individual combatant mobility and interaction in the synthetic environment.</li> <li>• 2500 - Establish inter-vehicle embedded simulation technology (INVEST) demonstrating a crew proficiency application with a Bradley Fighting Vehicle (BFV) trainer, including canned simulation scenario, image generator, vehicle driver display, virtual target injection and burst on/burst off target effects; assess tasks and skills to determine which are most appropriate for embedding; develop and deliver feasibility analysis study for embedded simulations; convert training objectives into embedded simulation goals.</li> <li>• 3990 - Develop and enhance the synthetic environment to support a division-sized battlefield; develop and evaluate open object-oriented architecture, including methods for model definition and VV&amp;A of networked simulations; continue development/testing of standards, expand terrain data base work, and evolve/refine data collection and analysis.</li> </ul> |   |                   |                     |   |                     |                     |                     |                           |                     |                     |            |
| Project AC90   |   |                   |                     | Page 3 of 6 Pages   |                     |                     |                     | Exhibit R-2 (PE 0602308A) |                     |                     |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
|--|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|-------|-------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|-------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602308A Modeling and Simulation Technology</b> |                              |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
|  | <b>PROJECT</b><br><b>AC90</b>  |                              |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| <ul style="list-style-type: none"> <li>• 227 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 9298</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 791 - Transition semi-automated force ( SAF) voice input/output technology; improve real C4I interfaces to CGF for varying echelons.</li> <li>• 1802 - Provide a demonstrated capability to fully immerse the live combatant in the synthetic environment, to include control of semi-automated forces through voice and gesture recognition.</li> <li>• 2500 - Prototype embedded simulation modular hardware and software components; prototype virtual-live interactive system; demonstrate unit proficiency application with the BFV simulator.</li> <li>• 4902 - Develop and enhance the synthetic environment to support a corps-sized battlefield; develop and evaluate open object-oriented architecture, including methods for model definition and VV&amp;A of networked simulations; continue development/testing of standards, expand terrain database work, and evolve/refine data collection and analysis.</li> </ul> <p>Total 9995</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 849 - Develop CGF capability for variable model fidelity; implement multi-resolution technology for full-force CGF implementation.</li> <li>• 2500 - Demonstrate mission specific application , including rapid scenario facility and mission-specific training in a networked environment, with BFV trainer; demonstrate vehicle-on-the-move (VOM) application with BFV prototype vehicle.</li> <li>• 4200 - Develop and enhance the synthetic environment to support an echelon above corps (EAC)-sized battlefield; develop and evaluate open object-oriented architecture, including methods for model definition and VV&amp;A of networked simulations.</li> <li>• 3300 - Continue standards development/testing, expand terrain data base work, and evolve/refine data collection and analysis.</li> </ul> <p>Total 10849</p> <p><b><u>B. Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">7859</td> <td style="text-align: center;">9516</td> <td style="text-align: center;">10121</td> <td style="text-align: center;">10416</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">7859</td> <td style="text-align: center;">9298</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-197</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">7662</td> <td style="text-align: center;">9298</td> <td style="text-align: center;">9995</td> <td style="text-align: center;">10849</td> </tr> </tbody> </table> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 7859 | 9516 | 10121 | 10416 | Appropriated Value | 7859 | 9298 |  |  | Adjustments to Appropriated Value | -197 |  |  |  | FY 1998 Pres Bud Request | 7662 | 9298 | 9995 | 10849 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| FY 1997 President's Budget   | 7859   | 9516                         | 10121          | 10416          |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Appropriated Value   | 7859   | 9298                         |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Adjustments to Appropriated Value  | -197   |                              |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| FY 1998 Pres Bud Request   | 7662   | 9298                         | 9995           | 10849          |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Project AC90   | Page 4 of 6 Pages  | Exhibit R-2 (PE 0602308A)    |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602308A Modeling and Simulation Technology</b> |                     |                           |                     | <b>PROJECT</b><br><b>AC99</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AC99 Advanced Concepts & Technology II (ACT II)  | 11804             | 11354               | 11064               | 13438  | 16685               | 14860                     | 7845                | 9189                          | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> Advanced Concepts and Technology II (ACT II) uses a yearly Broad Agency Announcement (BAA) to industry and academia, and provides a low-overhead, timely mechanism for the demonstration of mature, commercial-off-the-shelf (COTS) technologies, prototypes, software, and/or systems for assessment by the TRADOC Battle Labs. It evaluates new concepts through soldier-in-the-loop constructive and virtual simulations, electronic battlefield demonstrations and field tests, and modeling and simulation in real time. 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. All projects support and complement the Army computer technical architecture tenets. The ACT II goal is to advance a need from concept to demonstration to the soldier in one year.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 11804 - Conducted demonstrations and experiments in support of Battle Labs.             <ul style="list-style-type: none"> <li>- This effort includes the following activities:                 <ol style="list-style-type: none"> <li>(1) Released BAA to solicit Battle Lab-related concepts and technologies from the nation's industrial and academic communities.</li> <li>(2) Awarded/initiated 25 ACT II projects which will provide high payoff and innovative efforts for demonstration of warfighting capabilities.</li> <li>(3) Analyzed and evaluated the results of FY 1995 efforts; identified candidates for streamlined acquisitions.</li> </ol> </li> </ul> </li> </ul> <p>Total 11804</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 11076 - Conduct demonstrations and experiments in support of Battle Labs.             <ul style="list-style-type: none"> <li>- This effort includes the following activities:                 <ol style="list-style-type: none"> <li>(1) Release BAA to solicit Battle Lab-related concepts and technologies from the nation's industrial and academic communities.</li> <li>(2) Select, within resource constraints, high payoff and innovative efforts for demonstration of warfighting capabilities.</li> <li>(3) Award/initiate 20 ACT II projects which will provide high payoff and innovative efforts for demonstration of warfighting capabilities.</li> <li>(4) Analyze and evaluate the results of FY 1996 efforts; identify candidates for streamlined acquisitions.</li> <li>(5) Approve BAA topics for new ACT II projects to satisfy future Army and DoD needs not being addressed by existing programs.</li> </ol> </li> </ul> </li> <li>• 278 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 11354</p> |                   |                     |                     |  |                     |                           |                     |                               |                     |            |
| Project AC99   |                   |                     | Page 5 of 6 Pages   |  |                     | Exhibit R-2 (PE 0602308A) |                     |                               |                     |            |

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|---|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|-------|-------|-------|-------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602308A Modeling and Simulation Technology</b> | PROJECT<br><b>AC99</b>       |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 11064 - Conduct demonstrations and experiments in support of Battle Labs.</li> <li>• - This effort includes the following activities:             <ol style="list-style-type: none"> <li>(1) Release BAA to solicit Battle Lab-related concepts and technologies from the nation's industrial and academic communities.</li> <li>(2) Select, within resource constraints, high payoff and innovative efforts for demonstration of warfighting capabilities.</li> <li>(3) Analyze and evaluate the results of FY 1997 efforts; identify candidates for streamlined acquisitions.</li> <li>(4) Approve BAA topics for new ACT II projects to satisfy future Army and DoD needs not being addressed by existing programs.</li> </ol> </li> </ul> <p>Total 11064</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 13438 - Conduct demonstrations and experiments in support of Battle Labs.</li> <li>• - This effort includes the following activities:             <ol style="list-style-type: none"> <li>(1) Release BAA to solicit Battle Lab-related concepts and technologies from the nation's industrial and academic communities.</li> <li>(2) Select, within resource constraints, high payoff and innovative efforts for demonstration of warfighting capabilities.</li> <li>(3) Analyze and evaluate the results of FY 1998 efforts; identify candidates for streamlined acquisitions.</li> <li>(4) Approve BAA topics for new ACT II projects to satisfy future Army and DoD needs not being addressed by existing programs.</li> </ol> </li> </ul> <p>Total 13438</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">12108</td> <td style="text-align: center;">11618</td> <td style="text-align: center;">19436</td> <td style="text-align: center;">24110</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">12447</td> <td style="text-align: center;">11354</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-643</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">11804</td> <td style="text-align: center;">11354</td> <td style="text-align: center;">11064</td> <td style="text-align: center;">13438</td> </tr> </tbody> </table> <p>Change Summary Explanation:<br/>           Funding: FY 1998 Funds reprogrammed (-8372) to higher priority requirements.<br/>           FY 1999 Funds reprogrammed (-10672) to higher priority requirements.</p> |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 12108 | 11618 | 19436 | 24110 | Appropriated Value | 12447 | 11354 |  |  | Adjustments to Appropriated Value | -643 |  |  |  | FY 1998 Pres Bud Request | 11804 | 11354 | 11064 | 13438 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| FY 1997 President's Budget  | 12108   | 11618                        | 19436          | 24110          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Appropriated Value  | 12447   | 11354                        |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Adjustments to Appropriated Value   | -643  |                              |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| FY 1998 Pres Bud Request  | 11804   | 11354                        | 11064          | 13438          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Project AC99  | Page 6 of 6 Pages   | Exhibit R-2 (PE 0602308A)    |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 |                |                  |                  | PE NUMBER AND TITLE<br><b>0602601A Combat Vehicle and Automotive Technology</b> |                  |                  |                  |                  |                              |            |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete             | Total Cost |
| Total Program Element (PE) Cost                                | 35040          | 34312            | 37112            | 33360   | 31905            | 33165            | 34219            | 35062            | Continuing                   | Continuing |
| DC05 Armor Exploratory Development                             | 3799           | 5854             | 6572             | 7148  | 7121             | 7373             | 7523             | 7696             | Continuing                   | Continuing |
| DC83 TRACTOR CARD  | 1986           | 0                | 0                | 0   | 0                | 0                | 0                | 0                | 0                            | 1986       |
| DC84 TRACTOR TREAD   | 0              | 0                | 2007             | 2010  | 2006             | 2002             | 1997             | 1996             | Continuing                   | Continuing |
| AH39 Voice Instructional Device                                | 0              | 2056             | 0                | 0   | 0                | 0                | 0                | 0                | 0                            | 2056       |
| AH77 Advanced Automotive Technology                            | 9804           | 10318            | 12440            | 8445  | 8402             | 8843             | 9407             | 9707             | Continuing                   | Continuing |
| AH82 Non-Ozone Depleting Substance Technology                  | 5189           | 3025             | 2426             | 1354  | 0                | 0                | 0                | 0                | 0                            | 11994      |
| AH91 Tank & Automotive Technology                              | 14262          | 13059            | 13667            | 14403   | 14376            | 14947            | 15292            | 15663            | Continuing                   | Continuing |

**Mission Description and Budget Item Justification :** This 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 fielded ground vehicles and advanced future ground vehicle systems leading to more mobile, affordable, digitized, lightweight, versatile and highly survivable ground combat systems essential for the post Cold War era. New technology is integrated into innovative vehicle concepts aimed at achieving more deployable advanced 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 vehicle 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), which leverages commercial industry's large investment in automotive technology research and development and initiates shared technology programs that are directly focused on benefitting military ground vehicle systems. Two other NAC managed initiatives, Voice Instructional Device and Focus Hope, are also funded in this PE. In addition, the NAC also manages the TARDEC Small Business Innovation Research (SBIR) budget, executes selected SBIR projects and has a Budget Activity 1 component, the National Automotive Center (NAC), funded in PE 0601104A. The NAC has also been nominated as an Army early participant in the Dual Use Applications Program (DUAP). Work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Ground and Sea

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602601A Combat Vehicle and Automotive Technology</b> |                              |
| <p>Vehicle Defense Technology Area Plan (DTAP). 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</p> <p>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 project is coordinated with the Marine Corps office within the Naval Surface Warfare Center and ground vehicle developers within the Departments of Energy, Commerce and Transportation, and the Defense Advanced Research Projects Agency (DARPA). Projects in this PE include non-system specific development efforts directed toward specific military needs, and therefore are appropriate to Budget Activity 2.</p> |   |                              |
| <i>Page 2 of 16 Pages</i>  |   | Exhibit R-2 (PE 0602601A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>DC05</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| DC05 Armor Exploratory Development  | 3799              | 5854                | 6572                | 7148   | 7121                | 7373                | 7523                      | 7696                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project lays the technical foundation to solve critical armor deficiencies and improve the survivability of ground combat vehicles against increasingly lethal anti-armor weapons and mines. Supporting the ultimate objective of lighter, more deployable, more survivable vehicles, the emphasis is on armor technologies that will be compatible with armors suitable for upgrade of current and emerging combat systems (e.g., Abrams, Bradley, Crusader), and light weight structural technologies for advanced combat systems. The project also develops low-burden solutions to the protection of tactical vehicles in war and operations other than war focusing on appliqué armor for small arms and land mine protection. This project develops on armor technologies to complement innovative non-armor 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 ground combat systems: protection of combat and tactical vehicles against such threats as kinetic energy projectiles, explosively formed penetrators, chemical energy warheads, and blast and fragments from land mines. This project draws upon products from Army programs (e.g., PE 0602618A (Ballistic Technology) projects AH80 and 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 to assess armor configurations against different threats with sufficiently high fidelity. Other government agencies include: Jet Propulsion Lab, Pasadena, CA; National Institute of Standards and Technology (NIST), Gaithersburg, MD.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3799 - Demonstrated passive and energetic roof armor technologies which can defeat overhead threats.</li> <li style="padding-left: 20px;">- Enhanced medium vehicle upgrade armors to defeat medium caliber cannon.</li> <li style="padding-left: 20px;">- Verified smart armor penetrator/defeat mechanism interaction as predicted by hydrocode, and continued development of enhanced armor penetration codes to be used for armor component virtual prototyping, leading to reduction of armor development and production costs.</li> <li style="padding-left: 20px;">- Developed second generation protection kit for ballistic and mine protection of medium tactical trucks.</li> </ul> <p>Total 3799</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 980 - Demonstrate second generation protection technology for ballistic and mine protection of medium trucks.</li> <li>• 2498 - Demonstrate advanced energetic armor technology in armor configurations for medium combat vehicles.</li> <li>• 1600 - Demonstrate advanced armor configurations compatible with signature management techniques for combat vehicles.</li> <li>• 150 - Develop analytical methods for design of ceramic armors with maximum energy dissipation for defeat of kinetic energy (KE) threats.</li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project DC05  |                   |                     | Page 3 of 16 Pages  |  |                     |                     | Exhibit R-2 (PE 0602601A) |                              |                               |            |

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| BUDGET ACTIVITY   | PE NUMBER AND TITLE                                      | PROJECT                      |
| <b>2 - Applied Research</b>   | <b>0602601A Combat Vehicle and Automotive Technology</b> | <b>DC05</b>                  |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 500 - Develop and validate armor penetration mechanics model enhanced to include effects of energetic armors.</li> <li>• 126 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5854</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2230 - Demonstrate hybrid reactive armor for light weight future combat vehicle systems.               <ul style="list-style-type: none"> <li>- Develop advanced tandem defeat mechanism for the large tandem anti-tank guided missile (ATGM) threats to close combat vehicles.</li> <li>- Demonstrate advanced overhead protection technologies integrating threat defeat with combat vehicle requirements for vision systems and vehicle hatches.</li> </ul> </li> <li>• 1950 - Develop medium caliber kinetic energy (KE) defeat system and structures for protection of tanks and infantry fighting vehicles (IFVs).               <ul style="list-style-type: none"> <li>- Demonstrate improved smart armor KE threat defeat sensor to support technology selection for future combat systems.</li> <li>- Develop and validate analytical methods for design of ceramic armors with maximum energy dissipation for defeat of KE threats.</li> </ul> </li> <li>• 2392 - Validate armor penetration mechanics model augmented to include energetic armor effects to shorten design cycle and reduce test costs.               <ul style="list-style-type: none"> <li>- Initiate component demonstrations on a tactical wheeled vehicle to include advanced mine and rocket propelled grenade (RPG) protection.</li> </ul> </li> </ul> <p>Total 6572</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1950 - Develop lightweight alternative non-energetic reactive armor materials for future passive armors in medium and heavy vehicles.               <ul style="list-style-type: none"> <li>- Demonstrate combat vehicle armors incorporating the advanced tandem ATGM defeat mechanism.</li> <li>- Develop novel hypervelocity penetrator defeat mechanism to support future combat systems.</li> </ul> </li> <li>• 2098 - Develop low back pressure air intake/exhaust grille system with medium caliber protection to improve protection of fielded and developmental combat systems.               <ul style="list-style-type: none"> <li>- Validate analytical methods for design of ceramic armor design through use of analytical design models.</li> <li>- Demonstrate 25% reduction in typical test cost for armor design through use of analytical design models.</li> </ul> </li> <li>• 3100 - Develop integrated smart armor sensor package for KE threat defeat and demonstrate frontal armor system with 35% weight savings over baseline system.               <ul style="list-style-type: none"> <li>- Complete and test survivability appliquéés for tactical vehicles.</li> </ul> </li> </ul> <p>Total 7148</p> |  |                              |
| Project DC05  | <i>Page 4 of 16 Pages</i>                                | Exhibit R-2 (PE 0602601A)    |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602601A Combat Vehicle and Automotive<br/>Technology</b> |                              |                |                |
| PROJECT<br><b>DC05</b>   |   |                              |                |                |
| <b><u>B. Project Change Summary</u></b>                        | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget                                     | 3882  | 6314                         | 6280           | 6819           |
| Appropriated Value   | 3799  | 5854                         |                |                |
| Adjustments to Appropriated Value                              | 0   |                              |                |                |
| FY 1998 Pres Bud Request                                       | 3799  | 5854                         | 6572           | 7148           |
|  |   |                              |                |                |
| Project DC05   | Page 5 of 16 Pages  | Exhibit R-2 (PE 0602601A)    |                |                |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|--|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>AH39</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| AH39 Voice Instructional Device   | 0                 | 2056                | 0                   | 0  | 0                   | 0                   | 0                         | 0                             | 0                   | 2056       |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project was established for a NAC management effort in response to Congressional direction and funding only for the design, development and testing of a Voice Instructional Device (VID) for use with fuel tankers, the Palletized Loading System and M1022A1 Dolly Wheeled Hydraulic System. The VID provides audible instructions to its operator, providing voice instructions for diagnostics and maintenance.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2006 - Initiate a NAC effort, through a collaborative technology contract, for the design, development and test of Voice Instructional Device.</li> <li>• 50 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2056</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td></td> <td align="right">2056</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">2056</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 - Funding provided by Congress (+2056) for design, development and testing of a Voice Instructional Device.</p> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value |  | 2056 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 2056 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget  | 0                 | 0                   | 0                   | 0  |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value  |                   | 2056                |                     |  |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value   |                   |                     |                     |  |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request  | 0                 | 2056                | 0                   | 0  |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project AH39  |                   |                     | Page 6 of 16 Pages  |  |                     |                     | Exhibit R-2 (PE 0602601A) |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602601A Combat Vehicle and Automotive Technology</b> |                     |                     |                           |                              | PROJECT<br><b>AH77</b> |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| AH77 Advanced Automotive Technology   | 9804              | 10318               | 12440               | 8445  | 8402                | 8843                | 9407                      | 9707                         | Continuing             | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project funds the National Automotive Center (NAC), which leverages commercial industry's large investment in automotive technology research and development and initiates shared technology programs that are focused on benefiting military ground vehicle systems. The NAC, located at the Tank-Automotive and Armaments Command (TACOM), is part of the Tank-Automotive Research, Development and Engineering Center (TARDEC). The NAC serves as the catalyst linking industry, academia and government agencies for the development and exchange of automotive technologies. The NAC executes collaborative research and development (R&amp;D) contracts, cooperative agreements, and other initiatives to leverage commercial industry's investment in well-defined, high return-on-investment areas tied to key Army science and technology objectives for advanced land combat. The NAC focuses collaborative R&amp;D contracts on key military automotive technology thrust areas to include: mobility, electronics, propulsion, logistics, safety and environmental protection with the goal of (a) improving the performance and endurance of ground vehicle fleets, and (b) reducing ground vehicle design, manufacturing, production, and operating and support costs. Two-way industry/government technology transfer is pursued under Cooperative Research and Development Agreements (CRADAs). The activities of the NAC are supported by other government agencies via a linkage created under Memoranda of Agreement, and oversight is provided by a Senior Advisory Board which includes representation from program executive offices for tactical and combat vehicles, the User, the Army staff, the U.S. Marine Corps and OSD. These linkages permit the NAC to consolidate the collective expertise of federal government departments such as Energy, Transportation and Commerce and other DoD agencies. The NAC performs basic research in PE 0601104A, project BH73 (NAC) in addition to two efforts also funded in this PE, VID (see AH39) and Focus Hope (see AH91). The NAC also manages the TARDEC Small Business Innovation Research (SBIR) budget, and executes selected SBIR projects. Major contractors include: Environmental Institute of Michigan, Ann Arbor, MI; Science Applications International Corporation, Warren, MI; Radian Inc., Alexandria, VA; Michigan Technological University, Houghton, MI; Picotronics, Ann Arbor, MI; University of Michigan, Ann Arbor, MI; VSE, Alexandria, VA; Oakland University, Rochester, MI; TASC, Reading, MA; Ford, Dearborn, MI; Chrysler, Auburn Heights, MI; General Motors, Warren, MI (Cooperative Agreement); Optimetrics, Ann Arbor, MI; Wayne State University, Detroit, MI; Pinnacle Research, Los Gatos, CA; Southwest Research, San Antonio, TX; Westinghouse Electric, Pittsburgh, PA; Allied Signal, Stratford, CT; Failure Analysis, Redmond, WA; University of Detroit-Mercy, Detroit, MI; Barnes &amp; Reinicke, Troy, MI; ICRC Energy, LaLa, KA; University of Alaska, Fairbanks, AK; Cummins, Columbus, ID, VSE Corp., Alexandria, VA; University of Texas, Austin, TX; General Dynamics Land Systems, Sterling Heights, MI; Pentastar, Huntsville, AL; Baum, Romstedt Technology Research Corp. (BRTRC Inc.), Fairfax, VA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5000 - Awarded 13 new collaborative automotive technology contracts that focused on key commercial technology initiatives in electronics, safety, propulsion, environment, mobility, and logistics. Technology areas include corrosion protection, electromechanical suspensions, driver's automation aids, thermal imaging diagnostics for automotive components, and waste heat recovery/reutilization.</li> <li>- Completed collision warning system (CWS) demonstration which adapted a commercial automotive collision detection system to military vehicles to reduce convoy accidents and save soldier lives.</li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                        |            |
| Project AH77  |                   |                     | Page 7 of 16 Pages  |   |                     |                     | Exhibit R-2 (PE 0602601A) |                              |                        |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> | <b>PROJECT</b><br><b>AH77</b> |
| <p><b>FY 1996 Accomplishments: (continued)</b></p> <ul style="list-style-type: none"> <li>- Initiated a program to study and improve (reduced weight, increased efficiency, and reduced emissions) the HMMWV 6.2/6.5 liter engine by exploiting commercial Silicon Carbide Whisker Metal Matrix Composites to produce stronger engine parts of improved design.</li> <li>- Initiated a cooperative agreement to advance state of the art technology in high output diesel engine technology.</li> <li>- Performed a study to define requirements for a joint military/commercial technology demonstration program using advanced commercial technologies modified to conform to Army needs.</li> <li>• 4804 - Initiated a cooperative agreement for advancing the state of the art of four stroke direct injection (4SDI) diesel engine technology with Ford, General Motors, and Chrysler, directed toward improvement of military, as well as commercial, propulsion systems.</li> <li>- Initiated "Smart Truck" technology integration program that adapts commercial digital multiplexed databus technology on tactical wheeled vehicles to demonstrate rapid electronic commercial intelligent subsystem integration and interactive vehicle diagnostic capability.</li> <li>- Initiated a modeling/simulation effort to support evaluation and integration of technologies, including 4SDI diesel engine and smart truck.</li> <li>- Integrated key technologies from collaborative R&amp;D contracts into existing and new military demonstration programs. Key technologies include advanced traction control, hybrid batteries, and ultracapacitors.</li> </ul> <p>Total            9804</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5831 - Evaluate on-going collaborative R&amp;D contracts (from FY 1996) to award additional funding increments for high return-on-investment technologies.</li> <li>- Award competitive collaborative R&amp;D contracts or cooperative agreements, as appropriate, to acquire innovative and advanced commercial automotive technologies in the key military technology thrust areas of electronics, propulsion, safety, environment, mobility and logistics.</li> <li>- Continue Smart Truck technology integration demonstration program that adapts commercial digital multiplexed databus technology into tactical wheeled vehicles to include intelligent subsystems, such as global positioning system (GPS), navigation aids, collision warning devices, and communication links.</li> <li>• 4260 - Continue the cooperative agreement for advancing the state-of-the-art for four-stroke direct injection (4SDI) diesel with specific focus on high-temperature materials, exhaust after-treatments and low-heat rejection designs directed toward improvement of military propulsion systems.</li> <li>- Initiate a medium weight class combat vehicle chassis testbed program to evaluate advanced commercial hybrid electric drive components in cooperation with DARPA.</li> <li>- Continue the program to improve (reduce weight, increase efficiency and reduce emissions) the HMMWV diesel engine for enhanced military performance and continued commercial demand by exploiting NAC-funded commercial Silicon Carbide Whisker implantation to produce stronger and more efficient engine parts.</li> <li>• 227 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total            10318</p> |  |                               |
| Project AH77   |  | Exhibit R-2 (PE 0602601A)     |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |
|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|-------|--|--|--|--------------------------|------|-------|-------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> | <b>PROJECT</b><br><b>AH77</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6150 - Continue evaluation of FY97 collaborative contracts for additional funding increments for high return investment technologies.<br/>- Award collaborative R&amp;D contracts or cooperative agreements, as appropriate, to acquire innovative and advanced commercial automotive related technologies in key military areas of electronics, propulsion, safety, environment, mobility and logistics.</li> <li>• 5740 - Continue advancing the state-of-the-art for 4SDI diesel with special emphasis on the light truck, generator sets and hybrid vehicles.<br/>- Continue hybrid electric drive commercial application.<br/>- Initiate and coordinate development of an advanced automotive based product development software framework.<br/>- Continue Smart Truck program technology demonstration of commercial automotive data/communication links to all weight classes of tactical wheeled vehicles.</li> <li>• 550 - Demonstrate capabilities of Head Up displays for dual need applications.</li> </ul> <p>Total 12440</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5190 - Continue evaluation of FY97 and FY98 collaborative contracts or cooperative agreements, as appropriate, for additional funding increments for high return investment technologies.<br/>- Award collaborative R&amp;D contracts or cooperative agreements, as appropriate, to acquire innovative and advanced commercial automotive related technologies in key military areas of electronics, propulsion, safety, environment, mobility and logistics.<br/>- Continue automotive-based product development software framework.<br/>- Continue the Smart Truck program technology enhancements demonstration.</li> <li>• 3255 - Advance the state-of-the-art of 4SDI diesel engines.<br/>- Continue to expand collaborative effort to increase diesel engine efficiency/performance.<br/>- Expand hybrid electric drive commercial/military application.<br/>- Research and demonstrate advanced vision sensors and displays.</li> </ul> <p>Total 8445</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 15%; text-align: center;"><u>FY 1996</u></th> <th style="width: 15%; text-align: center;"><u>FY 1997</u></th> <th style="width: 15%; text-align: center;"><u>FY 1998</u></th> <th style="width: 15%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">12085</td> <td style="text-align: center;">11131</td> <td style="text-align: center;">12830</td> <td style="text-align: center;">14480</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">12424</td> <td style="text-align: center;">10318</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-2620</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">9804</td> <td style="text-align: center;">10318</td> <td style="text-align: center;">12440</td> <td style="text-align: center;">8445</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 12085 | 11131 | 12830 | 14480 | Appropriated Value | 12424 | 10318 |  |  | Adjustments to Appropriated Value | -2620 |  |  |  | FY 1998 Pres Bud Request | 9804 | 10318 | 12440 | 8445 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |
| FY 1997 President's Budget  | 12085  | 11131                         | 12830          | 14480          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |
| Appropriated Value  | 12424  | 10318                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |
| Adjustments to Appropriated Value   | -2620  |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |
| FY 1998 Pres Bud Request  | 9804   | 10318                         | 12440          | 8445           |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |
| Project AH77  |  | Exhibit R-2 (PE 0602601A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                          |      |       |       |      |

DATE  
**February 1997**

BUDGET ACTIVITY  
**2 - Applied Research**

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

Change Summary Explanation: Funding: FY 1996 - Funds reprogrammed to higher priority requirements (-2000); Congressional reductions and rescissions (-281).

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                            |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>AH77</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH82 Non-Ozone Depleting Substance Technology  | 5189              | 3025                | 2426                       | 1354   | 0                   | 0                   | 0                         | 0                             | 0                   | 11994      |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project demonstrates environmentally and toxicologically acceptable replacements for Halon 1301 in fire suppression systems in crew occupied compartments of ground combat vehicles. Due to the ozone depleting potential of Halon 1301, the Clean Air Act of 1990 and DoD Directive 6050.9 require that alternate extinguishing agents be identified to maintain current crew and vehicle survivability and supportability. Testing will be performed to meet Tier 1-3 Army Surgeon General and Environmental Protection Agency requirements. Funds in this project identify and evaluate non-ozone depleting substances for application to military vehicles. Investments to date have been successful in identifying two agents suitable for ground vehicle engine compartments. Work continues to find a suitable agent for crew compartments. Alternative agents are purchased from DuPont Inc., Deepwater, NJ and Great Lakes Chemical, Lafayette, IN.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5189 - Completed performance testing of two initial agents, FM-200 (Heptafluoropropane) and FE-13 (Trifluoromethane), in existing hardware.</li> <li style="padding-left: 20px;">- Reviewed tier 1 (short term single exposure) acute toxicity results and initiated tier 2 (longer term (14-90 Day) multiple exposure) subchronic toxicity testing.</li> <li style="padding-left: 20px;">- Conducted performance and toxicology review to downselect agent for vehicle testing .</li> <li style="padding-left: 20px;">- Selected three alternative agents to enter into testing, pending unsatisfactory review of initial agents.</li> </ul> <p>Total 5189</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2201 - Conduct performance testing on alternative agents.</li> <li>• 400 - Complete tier 2 (longer term (14-90 Day) multiple exposure) subchronic toxicity studies of alternative agents.</li> <li>• 350 - Initiate tier 3 (long term (1 year) multiple exposure) chronic toxicity studies, as required, based on tier 2 results.</li> <li>• 74 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3025</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1906 - Continue performance testing on alternate agents.</li> <li>• 300 - Continue tier 3 (long term; up to three years, multiple exposure) chronic toxicology studies.</li> </ul> |                   |                     |                            |  |                     |                     |                           |                               |                     |            |
| Project AH77   |                   |                     | <i>Page 10 of 16 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0602601A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|---|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> | <b>PROJECT</b><br><b>AH82</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 100 - Develop system design guidelines for alternate agents.</li> <li>• 120 - As a result of preliminary tier 2 studies, conduct toxicology studies of break-down products in alternate agents.</li> </ul> <p>Total 2426</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 900 - Complete performance testing on alternate agents.</li> <li>• 100 - Complete system design guidelines.</li> <li>• 304 - Complete long-term toxicology studies.</li> <li>• 50 - Complete breakdown product studies.</li> </ul> <p>Total 1354</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%;"></th> <th style="width: 15%; text-align: center;"><u>FY 1996</u></th> <th style="width: 15%; text-align: center;"><u>FY 1997</u></th> <th style="width: 15%; text-align: center;"><u>FY 1998</u></th> <th style="width: 15%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5323</td> <td style="text-align: center;">3262</td> <td style="text-align: center;">2420</td> <td style="text-align: center;">1342</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5189</td> <td style="text-align: center;">3025</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">0</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">5189</td> <td style="text-align: center;">3025</td> <td style="text-align: center;">2426</td> <td style="text-align: center;">1354</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5323 | 3262 | 2420 | 1342 | Appropriated Value | 5189 | 3025 |  |  | Adjustments to Appropriated Value | 0 |  |  |  | FY 1998 Pres Bud Request | 5189 | 3025 | 2426 | 1354 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 5323   | 3262                          | 2420           | 1342           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 5189   | 3025                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | 0  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 5189   | 3025                          | 2426           | 1354           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |
| Project AH82   | <i>Page 11 of 16 Pages</i>   | Exhibit R-2 (PE 0602601A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |   |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>AH82</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| AH91 Tank & Automotive Technology   | 14262             | 13059               | 13667               | 14403  | 14376               | 14947               | 15292                     | 15663                        | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides innovative vehicle concepts and component technologies leading to product improvements to fielded equipment and to the development of advanced systems that will enable the Army to maintain superiority to fight and survive against diverse threats. Conceptual designs, virtual prototyping, and performance analyses and battlefield wargaming of ground vehicle systems identify promising emerging technologies in support of Training and Doctrine Command (TRADOC) Integrated Concept Teams and quantify benefits, burdens and trade-offs related to ground vehicle applications. The project includes eight areas: (1) vehicle concepts and technology integration; (2) mobility; (3) integrated survivability; (4) vehicle electronics (VETRONICS) and digitization; (5) advanced vehicle structures; (6) simulation/analysis (7) military fuels and lubricants; and (8) water purification technology. Technology initiatives are being pursued to address advanced mobility, survivability and lethality requirements of lighter, digitized, more deployable vehicles. Activities are closely coordinated through the Army Training and Doctrine Command's Mounted and Dismounted Battlespace Battle Labs; Program Executive Office for Ground Combat and Support Systems; and the Army Research Laboratory (ARL)/ TACOM Advanced Armored Vehicle Technology focus program. This increases opportunities for transition of ARL corporate research into ground vehicles. Tank and automotive virtual prototyping provides seamless sharing of databases/engineering models, allowing more rapid and efficient integration, assessment and transfer of DoD and commercial vehicle technologies. Vehicle electronics will be based on adapting commercial electronic standards and architectures for combat vehicle battlefield unique requirements through the VETRONICS open system architecture (VOSA) to leverage commercial investments and facilitate upgrades to maintain pace with this rapidly evolving technology area. The survivability technologies, which include non-armor approaches such as signature reduction, countermeasures, and damage reduction, complement, but do not duplicate, work performed under the armor exploratory development project (DC05) in this PE. Executes a NAC initiative with Focus Hope to investigate advance materials manufacturing processes development to modify/retrofit diesel engine components for application to ground combat vehicles. Other government agencies include: Defense Advanced Research Projects Agency, Arlington, VA; Oakridge National Laboratory, Oakridge, TN; Red River Army Depot, Texarkana, TX. Major contractors include: Cadillac Gage Textron, New Orleans LA; Soucy International, Drummondville, Quebec; Pentastar Huntsville, AL; Michigan Technological University, Houghton MI; United Defense Limited Partnership, San Jose, CA; University of Texas, Arlington TX; Oakland University, Rochester Hills, MI; Gonzales Engineering, Troy, MI; McDonnell Douglas, St. Louis, MO; University of Dayton Research Center, Dayton, OH; Monterey Technologies Inc., Monterey, CA; DCS Corp, Alexandria, VA.; Texas Instruments, Dallas, TX; Southwest Research Institute, San Antonio, TX; Separation Systems Inc., San Diego, CA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5674 - Developed advanced tank, scout, and other combat vehicle concepts, via the virtual prototyping process, solid modeling and battlefield effectiveness analysis, performed a technology assessment, and assessed the battlefield impact and affordability of the projected systems and individual technologies.</li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project AH82  |                   |                     | Page 12 of 16 Pages |  |                     |                     | Exhibit R-2 (PE 0602601A) |                              |                               |            |



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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> | <b>PROJECT</b><br><b>AH91</b> |
| <p>- Completed initial design of baseline virtual prototyping architecture kernel to facilitate the transfer of design and performance information/data between distributed DoD and industry research and development groups.</p> <p><b>FY 1996 Accomplishments: (continued)</b></p> <ul style="list-style-type: none"> <li>• 5283 - Demonstrated advanced hybrid electric drive systems in tracked and wheeled vehicles in coordination with DARPA to determine the mission expansion capability of military vehicles with hybrid electric drives. Developed advanced enabling electric drive technologies in the areas of power electronics, storage devices and motors/generators to meet future vehicle needs. <ul style="list-style-type: none"> <li>- Developed band track for light vehicle class combat vehicle testbed to increase mobility and stealth; developed electric active suspension concepts to increase mobility and move toward all-electric vehicle. Developed semiactive suspension on 25-ton vehicle.</li> <li>- Evaluated high temperature diesel head materials, thermal barrier coatings for pistons and high temperature synthetic lubricants.</li> <li>- Completed transmission evaluations on candidate environmentally-compliant tactical engine oils and developed performance requirements for new 0W-30 arctic grade and transitioned to DLA; completed chromatographic analytical procedure evaluations for predicting fuel quality and initiated correlation programs.</li> <li>- Investigated emerging technologies such as aerogels, mosaic processes, laminated cellulose triacetate and interfacial polymerization of secondary amines. Interfacial polymerization showed the most potential for reverse osmosis membranes with chlorine resistance.</li> </ul> </li> <li>• 3305 - Completed preliminary characterization of non-linear optical protection materials and initiated development of novel fiber optic periscope design to enhance the dynamic range of combat vehicle vision device laser protection. <ul style="list-style-type: none"> <li>- Designed and tested improved ballistic grill system on a combat vehicle system; obtained initial validation of TARDEC visual signature virtual prototyping model; developed concepts for integrated signature armor.</li> <li>- Optimize VETRONICS architecture baseline for scout class vehicle.</li> </ul> </li> </ul> <p>Total 14262</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3379 - Perform advanced vehicle concept studies through virtual prototyping, solid modeling and battlefield effectiveness analysis to implement planning for and support of the TRADOC Integrated Concept Teams (ICTs). <ul style="list-style-type: none"> <li>- Complete detailed design of baseline virtual prototyping architecture which will demonstrate system/component level configuration management to enable distributed/concurrent ground vehicle technology development; demonstrate remote access of DoD virtual prototype models at selected locations; implement Janus model at TARDEC to perform operational effectiveness analysis.</li> </ul> </li> <li>• 4248 - Develop and test band track components for increased road wheel unit loading; develop noncausal active suspension algorithms using preview sensor data; demonstrate electric suspension in the laboratory. <ul style="list-style-type: none"> <li>- Conduct NATO Reference Mobility Model analysis of Future Scout Cavalry System mobility requirements as stated in the Operational Requirements Document.</li> </ul> </li> </ul> |  |                               |
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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> | <b>PROJECT</b><br><b>AH91</b> |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Complete contracted study to define technology for heavy combat vehicle diesel engine and methods for propulsion system volume reduction.</li> <li>- Complete correlation program of chromatographic analytical procedure(s) for predicting fuel performance properties from compositional measurements; develop software package for data integration and transition chromatographic analytical procedure(s) and model to Petroleum Quality Analysis System. Complete literature/market survey on energy enhancement technologies for ground fuel applications; complete laboratory characterization of experimental additives and blending ingredients.</li> <li>- Optimize operating property requirements of selected water purification technologies and conduct bench scale analysis of leading candidates which will meet or exceed the performance of reverse osmosis membranes.</li> <li>•           3877 - Initiate development of retrofittable wide angle optical viewing system design which can incorporate agile laser protection.</li> <li>                  - Complete advanced survivability evaluation using optimization tools for the assessment of reduced signature for a scout class vehicle. Complete fabrication of integrated low observable (LO) and ballistic skirts. Complete design and fabrication of integrated LO and ballistic laser warning receiver concept.</li> <li>                  - Develop architecture models for ground vehicle domain.</li> <li>•           1500 - Initiate an effort to investigate advance materials manufacturing processes development to modify/retrofit diesel engine components for application to ground combat vehicles, through the NAC via a collaborative automotive technology contract with Focus Hope.</li> <li>•           55 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> <li>Total           13059</li> </ul> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•           4725 - Based on the parametric analysis, develop computer generated vehicle concepts and complete preliminary concept assessments.</li> <li>                  - Support TRADOC ICTs with advanced concepts and analysis.</li> <li>                  - Perform concept level subsystem integration studies and tradeoff analysis for key FCS technologies.</li> <li>                  - Initiate an evaluation and refinement of the virtual prototyping architecture, verifying and validating the ability to reduce development time, cost and testing requirements when used in place of traditional development methods.</li> <li>•           4692 - Develop band track/components (drive and tensioner systems) for scout vehicle applications in the 22 ton weight class. Develop semiactive suspension for a scout class vehicle to increase cross country speed, improve ride and sensor platform stability. Design and fabricate high power density single cylinder engine based upon study results.</li> <li>                  - Complete demonstration of an innovative water purification technology to improve flow rate, shelf life, increased temperature and pH range and chlorine tolerance.</li> </ul> |  |                               |
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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602601A Combat Vehicle and Automotive Technology</b> | <b>PROJECT</b><br><b>AH91</b> |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• - Develop silicon carbide switches for ground vehicle electric drive application in conjunction with U.S. Navy. Demonstrate and evaluate combat vehicle applications of Power Electronics Building Blocks Metal Oxide Semiconductor controlled thyristors previously developed by the Navy and Air Force.</li> <li>• 3250 - Define optimum survivability suite for scout class vehicle.             <ul style="list-style-type: none"> <li>- Continue development of agile laser protected wide angle vision system.</li> <li>- Demonstrate and validate ground vehicle reusable crew station simulation architecture.</li> <li>- Test integrated signature ballistic air intake grille system and integrated LO and ballistic skirts.</li> </ul> </li> <li>• 1000 - Complete the NAC managed Focus Hope advance material manufacturing processes development and demonstrate production of diesel engine components for Army ground vehicles.</li> </ul> <p>Total 13667</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5245 - Perform concept level engineering and operational effectiveness analysis on future combat system concepts in support of Armor/Infantry Centers.             <ul style="list-style-type: none"> <li>- Provide technology tradeoff analysis based on future combat systems requirements.</li> <li>- Complete evaluation and refinement of the virtual prototyping architecture, verifying and validating the ability to reduce development time, cost and testing requirements when used in place of traditional development methods.</li> </ul> </li> <li>• 5633 - Test nitrile rubber track for durability. Develop track tensioning system for heavy vehicle applications. Develop a lightweight aluminum metal matrix track for heavy combat vehicle applications.             <ul style="list-style-type: none"> <li>- Develop semiactive suspension for improved cross-country performance of heavy combat vehicle class; develop electric actuators for active suspension units for both light and heavy all-electric combat vehicles.</li> <li>- Integrate compact silicon carbide power electronics into ground vehicle electric drive demonstrator; develop single cylinder high power density diesel engine for performance and durability.</li> <li>- Evaluation of candidate fuel energy enhancement materials at two locations using fleets encompassing cross section of Army combat and tactical vehicles and equipment; develop user guidance for materials and transition to DLA.</li> </ul> </li> <li>• 3525 - Demonstrate retrofittable wide angle optical viewing system design which can incorporate laser limiting materials.             <ul style="list-style-type: none"> <li>- Demonstrate integrated signature-ballistic side armor system for light and medium weight future vehicle systems.</li> <li>- Define ground vehicle reusable software application program interface (API) baseline.</li> </ul> </li> </ul> <p>Total 14403</p> |  |                               |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |                           |                |
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|  | <b>PROJECT</b><br><b>AH91</b>  |                              |                           |                |
| <b><u>B. Project Change Summary</u></b>                        | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget                                     | 14802  | 14127                        | 15160                     | 15924          |
| Appropriated Value   | 14262  | 13340                        |                           |                |
| Adjustments to Appropriated Value                              | 0  | -281                         |                           |                |
| FY 1998 Pres Bud Request                                       | 14262  | 13059                        | 13667                     | 14403          |
|  |  |                              |                           |                |
| Project AH91   | <i>Page 16 of 16 Pages</i>   |                              | Exhibit R-2 (PE 0602601A) |                |

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602618A Ballistics Technology</b> |                     |                           |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 34647             | 39913               | 33317               | 37598   | 34612               | 37878                     | 38709               | 40366                        | Continuing          | Continuing |
| AH37 Liquid Propellant Technology  | 0                 | 7343                | 0                   | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 7343       |
| AH75 Electric Gun Technology   | 7585              | 7839                | 8032                | 10159   | 6865                | 7215                      | 7181                | 7239                         | Continuing          | Continuing |
| AH80 Ballistics Technology   | 20433             | 20328               | 20998               | 22642   | 23069               | 25409                     | 26168               | 27643                        | Continuing          | Continuing |
| AH81 Armor/Anti-Armor Technology   | 6629              | 4403                | 4287                | 4797  | 4678                | 5254                      | 5360                | 5484                         | Continuing          | Continuing |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> This program element (PE) provides ballistic technologies required for armaments and armor to allow U.S. dominance in future conflicts across a full spectrum of threats in a global context. Project AH37 is directed toward solving the remaining technology challenges identified under previous attempts to weaponize liquid propellant (LP) technology. It capitalizes on the large Army investment in LP technology. Project AH75 focuses on pulsed power technologies for electric armaments which offer the potential to field leap-ahead capability in providing hypervelocity and hyperenergy launch well above the ability of the conventional cannon. It also includes work in hypervelocity penetrator effectiveness and electrothermal chemical (ETC) technology that will greatly increase anti-armor capabilities. Project AH80 is focused on applied research in ballistics technologies including warhead mechanics, penetrator mechanics, munition-target interactions, terminal effects, propulsion dynamics, launch and flight dynamics, remote sensing and computational physics. Corresponding emphasis is placed on advanced armor technology and vulnerability, lethality and survivability analysis technologies 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. Work in this program element has been coordinated with the other military services through the Weapons Technology Area Plan to prevent duplication of effort and to maximize the return on investment. One result of this process is the Army's leveraging of Navy and Defense Special Weapons Agency investments for ETC technology demonstrations. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |
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|--|-------------------|---------------------|--------------------------|---|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |   |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                          | <b>PE NUMBER AND TITLE</b><br><b>0602618A Ballistics Technology</b> |                     |                           |                     | <b>PROJECT</b><br><b>AH37</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| AH37 Liquid Propellant Technology  | 0                 | 7343                | 0                        | 0   | 0                   | 0                         | 0                   | 0                             | 0                   | 7343       |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project will focus on maturation of liquid propellant (LP) technology with the intent to evaluate LP as a means of achieving increased lethality and/or survivability for future weapon systems applications. Technology challenges including pressure oscillations, material compatibility, and reliability/durability of the propellant in a battlefield environment will be addressed and advantages of an LP weapon will be explored.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7164 -Identify improved hydroxyl ammonium nitrate (HAN)-based propellant(s) with potential for increasing muzzle energy of an LP gun over conventional powder gun. <ul style="list-style-type: none"> <li>-Conduct studies and tests to show improved performance of LP formulations with reduced pressure oscillations.</li> <li>-Acquire thermal stability data on liquid propellants with stabilizing additives.</li> <li>-Develop improved ballistic models for LP ; conduct ballistic tests on improved LP formulations and use data to validate models.</li> <li>-Obtain jet breakup and propellant decomposition data using liquid propellant at low pressure.</li> </ul> </li> <li>• 179 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 7343</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1996</u></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">0</td> <td style="text-align: center;">7343</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">7343</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> <p style="margin-left: 40px;">Change Summary Explanation: Funding: FY 1997-Project established by Congress to focus efforts on liquid propellant applied research.</p> |                   |                     |                          |   |                     |                           |                     |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 7343 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 7343 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>           | <u>FY 1999</u>  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget   | 0                 | 0                   | 0                        | 0   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value   | 0                 | 7343                |                          |   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value  |                   |                     |                          |   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request   | 0                 | 7343                | 0                        | 0   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project AH37   |                   |                     | <i>Page 2 of 9 Pages</i> |   |                     | Exhibit R-2 (PE 0602618A) |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |                   |                  |                  |   |                  |                  |                           | DATE<br>February 1997 |                  |            |
|--|-------------------|------------------|------------------|---|------------------|------------------|---------------------------|-----------------------|------------------|------------|
| BUDGET ACTIVITY<br>2 - Applied Research  |                   |                  |                  | PE NUMBER AND TITLE<br>0602618A Ballistics Technology |                  |                  |                           | PROJECT<br>AH75       |                  |            |
| COST (In Thousands)  | FY 1996 Actual    | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate                                      | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate      | Cost to Complete | Total Cost |
| AH75 Electric Gun Technology   | 7585              | 7839             | 8032             | 10159   | 6865             | 7215             | 7181                      | 7239                  | Continuing       | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides oversight and accountability for the Army electric armaments technology program, which is managed by the Army Research Laboratory (ARL). Future armored combat vehicles will require more lethal, yet compact main armament systems capable of defeating protection levels greatly in excess of currently experienced values. Electric armaments offer the potential to field a leap-ahead capability by providing hypervelocity and/or hyperenergy launch greatly above the ability of the conventional cannon. Electric armaments potentially can be fully integrated with electric propulsion and electromagnetic armor systems to provide the efficient, highly mobile, and deployable armored force required by the nation. This project funds a contractual effort to develop an efficient pulsed power system for electromagnetic (EM) launch. The goal is to demonstrate pulse power technology (rotating machines) with energy density of three Joules per gram (J/g) and to identify a clear potential for growth to ten J/g. In addition, this project supports the development of electrothermal chemical (ETC) technology which is a joint effort with the Defense Special Weapons Agency (DSWA). The goal of the ETC effort is to demonstrate 140mm lethality from a 120mm cannon.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2661 - Developed and evaluated three candidate ETC concepts for 120mm. <ul style="list-style-type: none"> <li>- Rebuilt subscale compulsator rotor.</li> <li>- Tested compulsator into a static load.</li> <li>- Integrated compulsator with 45mm railgun and tested into a dynamic load.</li> </ul> </li> <li>• 4924 - Developed switching and rectifiers for self-excitation. <ul style="list-style-type: none"> <li>- Designed and began fabrication of fully compensated machine.</li> <li>- Designed and tested high performance armature/launch packages.</li> </ul> </li> </ul> <p>Total 7585</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5647 - Complete subscale rotor and conduct performance tests to validate fabrication and design; demonstrate full machine rotational rate, structural integrity, and energy density of 1.5 J/g. <ul style="list-style-type: none"> <li>- Initiate design of a compulsator which will demonstrate energy density of 3 J/g (Exit Criteria Machine - ECM) including required switching and power conditioning electronics.</li> <li>- Conduct experiments to validate performance potential of state-of-the-art switching and power conditioning electronics for the ECM.</li> </ul> </li> <li>• 2000 - Conduct reduced scale tests of up to six ETC-ignition and propulsion concepts.</li> <li>• 192 - Small business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> |                   |                  |                  |   |                  |                  |                           |                       |                  |            |
| Project AH75   | Page 3 of 9 Pages |                  |                  |   |                  |                  | Exhibit R-2 (PE 0602618A) |                       |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602618A Ballistics Technology</b> | <b>PROJECT</b><br><b>AH75</b> |                |                |
| <p>Total 7839</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6232 - Test subscale rotor to 12,000 rpm and demonstrate full electrical performance through both static and dynamic load representative of an EM launcher.<br/>- Conduct critical component tests to validate ECM design and initiate fabrication of compulsator based on validated design.</li> <li>• 1800 - Conduct tests to demonstrate potential of two ETC-ignition and propulsion systems in 120mm, M256 cannon.</li> </ul> <p>Total 8032</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7959 - Complete fabrication of ECM and demonstrate energy density of 3 J/g through a representative dynamic load.<br/>- Provide a clear technology roadmap to achieving energy density of 10 J/g.</li> <li>• 2200 - Test the single best ETC-ignition concept to demonstrate 140mm performance (17 MJ muzzle energy) in a 120mm XM291 cannon.</li> </ul> <p>Total 10159</p> |   |                               |                |                |
| <b>B. Project Change Summary</b>   |   |                               |                |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 7781  | 5407                          | 6346           | 7427           |
| Appropriated Value   | 8000  | 7839                          |                |                |
| Adjustments to Appropriated Value  | -415  |                               |                |                |
| FY 1998 Pres Bud Request   | 7585  | 7839                          | 8032           | 10159          |
| <p>Change Summary Explanation: FY 1997 Congressional add (+2600) for electric gun development.<br/> FY 1998 funding increased (+1686) to provide critical increased level of effort in EM pulse power development.<br/> FY 1999 funding increased (+2732) to provide critical increased level of effort in EM pulse power development.</p>   |   |                               |                |                |
| <p>Project AH75 <span style="float: right;">Page 4 of 9 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0602618A)</span></p>  |   |                               |                |                |



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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602618A Ballistics Technology</b> |                     |                           |                     | PROJECT<br><b>AH80</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AH80 Ballistics Technology  | 20433             | 20328               | 20998               | 22642  | 23069               | 25409                     | 26168               | 27643                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project produces key technologies required for armaments and armor to allow U.S. dominance in future conflicts across a full spectrum of threats in a global context. This project supports 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 effective weapon capabilities and optimally protect against the most dangerous threats. Emphasis will be placed on advancement of simulation and modeling technologies to foster the exploitation of the Army's supercomputer network. The modeling and simulation tools created are used to produce analyses that support the independent evaluation process for acquisition milestone decisions. This project continues to support extensive experimental programs to advance the state-of-the-art in ballistics technologies.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 11314 - Investigated diode laser technology for the direct ignition of solid/liquid propellants and modeled inbore and free flight projectile stability, surface heating and ablation of hypervelocity projectiles.             <ul style="list-style-type: none"> <li>- Demonstrated an armor capable of defeating projectiles over a wide velocity spectrum.</li> <li>- Integrated ETC tank cartridge (plasma generator, bullets, propellant), and demonstrated improved electrical enhancement factors while maintaining enhanced performance.</li> <li>- For spinning projectiles or submunitions, developed a rotation-compensated warhead concept; for long rod penetrators, demonstrated a micro-rocket motor to reduce drag.</li> </ul> </li> <li>• 9119 - Integrated target acquisition, image stabilization and target cueing with the inertial reticle system fire control for secondary armament.             <ul style="list-style-type: none"> <li>- Implemented ballistic shock and secondary spall algorithms in the stochastic vulnerability/lethality analysis code in support of live-fire test and evaluation of U.S. Army systems.</li> <li>- Simulated the resin transfer molding processes used by United Defense for manufacturing Composite Armored Vehicle components.</li> <li>- Improved distributed interactive simulation (DIS) compliant smoke/obscurants models for insertion into synthetic environments.</li> </ul> </li> </ul> <p>Total 20433</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 15558 - Develop enabling technologies for lightweight weapons and focused warhead effects for the light and special operations forces, which improve their effectiveness in remote locations and in operations other than war.             <ul style="list-style-type: none"> <li>- Test artillery projectile technologies which provide gliding flight and enhanced accuracy for extended range.</li> <li>- Provide technology to enhance weapon lethality for applications such as long standoff, counter active protection and missile applications.</li> </ul> </li> </ul> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| Project AH80  |                   |                     | Page 5 of 9 Pages   |  |                     | Exhibit R-2 (PE 0602618A) |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602618A Ballistics Technology</b>   | PROJECT<br><b>AH80</b>       |
| <b>FY 1997 Planned Program: (continued)</b>                    |  |                              |
|  | - Demonstrate technologies to allow lightweight protection of armored systems to advanced threats such as kinetic energy weapons and top attack weapons.   |                              |
|  | - Develop unique armor and armaments technologies which will provide synergy with battlefield digitization to enhance both lethality and survivability.  |                              |
|  | - Conduct theoretical and experimental studies of novel gun propulsion concepts for laboratory and weapon system applications to provide the energy required to defeat evolving threats.   |                              |
|  | - Develop thick composite technology using resin transfer molding process.   |                              |
| • 3821   | - Develop engineering-based methods to compute ballistic damage response and performance of combat system components, including main rotor blades, drive trains, and electro-optics.   |                              |
| • 949  | - Demonstrate integration of the multi-user prototype synthetic environment with computer generated individual combatants. Develop mission planning and rehearsal tools simulating the battlefield to quickly adjust mission plans to changing battlefield situations. |                              |
| Total  | 20328  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 14633  | -Advance technologies such as recoil mitigation and advanced warheads which will provide enhanced capabilities for light forces in operations across the threat spectrum. Develop weaponry which addresses the needs of soldiers in operations other than war.         |                              |
|  | -Apply advanced sensing and guidance technology to artillery projectiles, missiles and fire control concepts to provide improved weapon accuracy and associated relief from logistic burden.   |                              |
|  | -Enhance direct fire lethality by introducing novel propulsion concepts and advanced warhead designs including multi-stage shaped charge and kinetic energy precursor technology.  |                              |
|  | -Investigate advanced basal and appliqué armor technology which, combined with lightweight structures, will provide new approaches to armoring vehicles.   |                              |
| • 4273   | -Implement blast damage algorithm for component damage from small warheads to optimize lethality/survivability of smart indirect-fire munitions /ground systems.   |                              |
| • 2092   | -Implement physical models of vulnerability and weapons effects in real time for interactive simulations.  |                              |
| Total  | 20998  |                              |
| Project AH80   | Page 6 of 9 Pages  | Exhibit R-2 (PE 0602618A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
|---|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|-------|-------|-------|-------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602618A Ballistics Technology</b> | PROJECT<br><b>AH80</b>       |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 14143 -Determine the effects of advanced propellant technology on gun tube erosion and gun accuracy; investigate advances in direct fire lethal mechanisms.<br/>-Optimize guidance and flight technologies to extend range and improve accuracy of indirect fire weaponry.<br/>-Develop technology which will provide new operational capabilities to soldiers in low intensity conflicts and operations other than war.<br/>-Enhance the armor technology base to address the lethality of advanced threats.</li> <li>• 6527 -Implement vulnerability/lethality ballistics methodologies in a server configuration incorporating engineering technologies into higher level models.<br/>-Provide engineering-based predictions of the sub-system capabilities of air and ground combat platforms after multiple impact combinations of direct- and/or indirect-fire threats.</li> <li>• 1972 -Develop and demonstrate interaction between untethered and tethered soldiers via DIS in a synthetic environment that includes realistic simulations of physical models of weapons systems, ballistic effects, vehicle systems, and sensor systems..</li> </ul> <p>Total      22642</p> |  |                              |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">20520</td> <td style="text-align: center;">21262</td> <td style="text-align: center;">22260</td> <td style="text-align: center;">25333</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">21099</td> <td style="text-align: center;">20328</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-666</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">20433</td> <td style="text-align: center;">20328</td> <td style="text-align: center;">20998</td> <td style="text-align: center;">22642</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1999 funds reprogrammed (-2691) to higher priority requirements.</p>                |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 20520 | 21262 | 22260 | 25333 | Appropriated Value | 21099 | 20328 |  |  | Adjustments to Appropriated Value | -666 |  |  |  | FY 1998 Pres Bud Request | 20433 | 20328 | 20998 | 22642 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| FY 1997 President's Budget  | 20520  | 21262                        | 22260          | 25333          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Appropriated Value  | 21099  | 20328                        |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| Adjustments to Appropriated Value   | -666   |                              |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| FY 1998 Pres Bud Request  | 20433  | 20328                        | 20998          | 22642          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |
| <p>Project AH80 <span style="float: right;">Page 7 of 9 Pages      Exhibit R-2 (PE 0602618A)</span></p>   |  |                              |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |       |       |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                          |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|--------------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                          | PE NUMBER AND TITLE<br><b>0602618A Ballistics Technology</b> |                     |                     |                           | PROJECT<br><b>AH81</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AH81 Armor/Anti-Armor Technology  | 6629              | 4403                | 4287                     | 4797   | 4678                | 5254                | 5360                      | 5484                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> The 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, Defense Advanced Research Projects Agency (DARPA), and the U.S. Marine Corps to enhance the national capability in armor/anti-armor (A3) technologies, and has been funded only by the Army since FY 1994. All of the funds in this project are used to fund contractual work to tap innovative ideas of industry. Major contractors include: Dow Chemical Co., Midland, MI; Kaman Sciences, Colorado Springs, CO; Simula Inc., Phoenix, AZ; GDLS, Warren, MI.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4629 - Developed warheads and penetrators capable of defeating explosive reactive armor. <ul style="list-style-type: none"> <li>- Performed live fire tests to defeat explosive reactive appliqué target with gun launched kinetic energy (KE) projectiles incorporating KE precursor concepts.</li> <li>- Investigated technical approaches to integration of ballistic protection against overhead attack with signature management technologies.</li> <li>- Initiated development of fuze for active protection system (APS) defeat.</li> </ul> </li> <li>• 2000 - Identified and analyzed existing liquid propellant (LP) technical barriers, prior to design of a high performance LP gun.</li> </ul> <p>Total 6629</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2608 - Complete KE precursor concept development for explosive reactive armor (ERA) defeat and down-select final configuration.</li> <li>• 1695 - Support demonstration of integrated survivability approaches to overhead threats. <ul style="list-style-type: none"> <li>- Continue development of warhead for APS defeat.</li> </ul> </li> <li>• 100 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4403</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2622 - Complete KE precursor final design and transition to PE 0603004A, Proj D232, for cartridge integration. <ul style="list-style-type: none"> <li>- Initiate exploration of novel penetrator designs to defeat advanced armor systems.</li> </ul> </li> <li>• 1665 - Develop integrated top attack and smart armor concepts into lightweight structures employing titanium and other lightweight materials.</li> </ul> <p>Total 4287</p> |                   |                     |                          |  |                     |                     |                           |                              |                     |            |
| Project AH81  |                   |                     | <i>Page 8 of 9 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0602618A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|---|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602618A Ballistics Technology</b> | PROJECT<br><b>AH81</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•           1957 - Continue integration and demonstrate integrated top attack and smart armor concepts into lightweight structures employing titanium and other lightweight materials.</li> <li>            2840 - Select and demonstrate novel penetrator designs for full scale testing.</li> <li>                                  - Initiate design of critical componentry for extended range munitions for tanks.</li> </ul> <p>Total           4797</p>  |  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4744</td> <td style="text-align: center;">4497</td> <td style="text-align: center;">4844</td> <td style="text-align: center;">5845</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4877</td> <td style="text-align: center;">4403</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">1752</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">6629</td> <td style="text-align: center;">4403</td> <td style="text-align: center;">4287</td> <td style="text-align: center;">4797</td> </tr> </tbody> </table> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4744 | 4497 | 4844 | 5845 | Appropriated Value | 4877 | 4403 |  |  | Adjustments to Appropriated Value | 1752 |  |  |  | FY 1998 Pres Bud Request | 6629 | 4403 | 4287 | 4797 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 4744   | 4497                         | 4844           | 5845           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 4877   | 4403                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | 1752   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 6629   | 4403                         | 4287           | 4797           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p>Change Summary Explanation: Funding: FY 1996: funds increased (+1885) to support technical efforts to address barriers to the development of a liquid propellant gun.</p> <p style="padding-left: 100px;">FY 1998: funds reprogrammed (-557) to higher priority requirements.</p> <p style="padding-left: 100px;">FY 1999: funds reprogrammed (-1048) to higher priority requirements.</p>   |  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AH81  | <i>Page 9 of 9 Pages</i>                                     | Exhibit R-2 (PE 0602618A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602622A Chemical, Smoke and Equipment</b><br><b>Defeating Technology</b> |                     |                     |                     |                              | <b>PROJECT</b><br><b>A552</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| A552 Smoke/Novel Effects Munitions  | 1728              | 2259                | 4739                | 6691   | 4167                | 4231                | 4314                | 4411                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Budget Item Justification:</u></b> This program element provides exploratory development of technologies to 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). Project A552 provides exploratory development of several capabilities essential to counter 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, affordable and efficient screening of deployed forces from threat force surveillance sensors and effective defeat of target acquisition devices, missile guidance, and directed energy weapons, all of which can operate anywhere 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. Efforts in this Program Element include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1000 -Evaluated degradable and environmentally safe millimeter wave (MMW) screening obscurant candidates; conducted modeling and simulation of MMW screening defeat mechanism; initiated packaging and dissemination studies of candidate degradable MMW material; addressed affordability issues.</li> <li>• 385 -Evaluated novel smoke/obscurant/marketing materials.</li> <li>• 343 -Conducted technical watch level of effort on flame, incendiary, antimateriel, riot control and non-lethal technologies.</li> </ul> <p>Total 1728</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1000 -Evaluate degradable and environmentally safe MMW screening obscurant candidates and conduct field trials; conduct packaging and dissemination studies; continue to investigate affordability issues.</li> <li>• 860 -Evaluate rapid obscuration concepts for combat vehicles.</li> <li>• 363 -Conduct technical watch level of effort on flame, incendiary, antimateriel, riot control and non-lethal technologies.</li> <li>• 36 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2259</p> <p>Project A552</p> |                   |                     |                     |  |                     |                     |                     |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602622A Chemical, Smoke and Equipment<br/>Defeating Technology</b> | <b>PROJECT</b><br><b>A552</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1000 -Evaluate degradable and environmentally safe MMW screening obscurant candidates and conduct field trials; conduct packaging and dissemination studies; continue to investigate affordability issues.</li> <li>• 700 -Evaluate rapid obscurant concepts for combat vehicles.</li> <li>• 600 -Investigate materials for flame, incendiary, antimateriel, riot control and non-lethal materials.</li> <li>• 1783 -Integrate millimeter wave module with the M56 smoke generator and its associated carrier; incorporate mission and operational cost reduction measures.</li> <li>• 656 -Investigate candidate infrared screening materials for projectile and light (non-armor) vehicles.</li> </ul> <p>Total 4739</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2891 -Evaluate rapid obscurant concepts and integrate survivability measures and concepts for armored vehicles.</li> <li>• 800 -Investigate new materials for flame, incendiary, anti-materiel and riot control.</li> <li>• 2000 -Complete integration of millimeter wave module with the M56 smoke generator; incorporate mission and operational cost reduction measures; conduct field test of system; transition to development.</li> <li>• 1000 -Investigate candidate infrared screening materials for projectiles and light (non-armor) vehicles.</li> </ul> <p>Total 6691</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1760</td> <td style="text-align: center;">2343</td> <td style="text-align: center;">2954</td> <td style="text-align: center;">3696</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1891</td> <td style="text-align: center;">2259</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-163</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1728</td> <td style="text-align: center;">2259</td> <td style="text-align: center;">4739</td> <td style="text-align: center;">6691</td> </tr> </tbody> </table> <p>Change Summary Explanation:</p> <p style="padding-left: 40px;">Funding: FY1998 Congressional plus-up (+1785) for additional efforts on the millimeter wave module and infrared screening materials.<br/>FY1999 Congressional plus-up (+2995) for additional efforts on the millimeter wave module and infrared screening materials.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1760 | 2343 | 2954 | 3696 | Appropriated Value | 1891 | 2259 |  |  | Adjustments to Appropriated Value | -163 |  |  |  | FY 1998 Pres Bud Request | 1728 | 2259 | 4739 | 6691 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 1760   | 2343                          | 2954           | 3696           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 1891   | 2259                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -163   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 1728   | 2259                          | 4739           | 6691           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project A552   | Page 2 of 2 Pages  | Exhibit R-2 (PE 0602622A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602623A Joint Service Small Arms Program</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>AH21</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| AH21 Joint Service Small Arms Program   | 4857              | 4497                | 4786                | 5204   | 5183                | 5366                | 5473                      | 5597                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Budget Item Justification:</u></b> The objective of this Program Element (PE) is to develop key individual and crew served weapons technologies that will enhance the fighting capabilities and survivability of dismounted battlefield personnel of the Services. This PE funds several efforts including the following: component technology for an Objective Crew-Served Weapon (OCSW) to replace selected M2 machine guns and MK19 grenade machine guns; bursting munitions technology to provide a 300% to 500% increase in hit probability, the ability to defeat defilade or non-visible targets, and means to extend the effective range of the Objective Individual Combat Weapon (OICW) to 1000 meters and the OCSW to 2000 meters; non-conventional target effects (NCTE) technologies for small arms-size directed energy systems (lasers/acoustics/microwaves), increased hit/incapacitation/suppression capabilities with controllable target effects (lethal to less-than-lethal); other fighting technology alternatives (FTA) promoting significant generic advances in function or form of small arms via a spectrum of applications from product improvements through all new weapon concepts (advanced materials and structures for gun systems, guided bullets, and explosively launched projectiles); personal weapon technology leading to a more effective Objective Personal Weapon (immediate incapacitation of body armored personnel out to 50 meters); an objective sniper weapon technology to increase accuracy and effective range to 2000 meters for the next sniper weapon; technology to provide alternative, non-toxic components for small caliber ammunition, to dramatically reduce future environmental contamination during training and enable the Services to comply with applicable statutes; Advanced Medium Machine Gun (AMMG) technology effort to provide a lighter, more effective/versatile system to replace current 7.62mm medium machine guns; and technology efforts leading to improved capabilities for all of the Objective Family of Small Arms. The bursting munition technology development supports the OICW Advanced Technology Demonstration (ATD). 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), plus Mission Needs Statements and Operational Requirements Documents of the Services. The work in this PE is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. This program is primarily managed by the U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology), PE 0603607A (Joint Service Small Arms Program), and will transition to JSSAP efforts conducted in PE 0604802A (Weapons and Munitions-Engineering Development) and PE 0604601A (Objective Crew Served Weapon-Engineering Development). Additional transition paths have been established in coordination with Product Manager (PM) Small Arms, USMC Program Manager (PM) Ground Weapons and US SOCOM. This project includes non-system specific development aimed at specific military needs and therefore is appropriate to Budget Activity 2.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3761 - Developed simulation technology for the OICW.</li> <li style="padding-left: 20px;">- Finalized trade-off determination for OCSW.</li> <li style="padding-left: 20px;">- Demonstrated critical sub-system component technologies (i.e., bursting munitions, miniature fuzing, enhanced fragmentation, composite weapon/mount components) for OCSW.</li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project AH21  |                   |                     | Page 1 of 3 Pages   |  |                     |                     | Exhibit R-2 (PE 0602623A) |                              |                               |            |



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|---|--|------------------------------|
| BUDGET ACTIVITY   | PE NUMBER AND TITLE                              | PROJECT                      |
| <b>2 - Applied Research</b>   | <b>0602623A Joint Service Small Arms Program</b> | <b>AH21</b>                  |
| <p align="center">- Initiated transition of OCSW technologies for technology demonstration.</p> <p><b>FY 1996 Accomplishments: (continued)</b></p> <ul style="list-style-type: none"> <li>• 714 - Conducted Blue Team technology review/evaluation of Broad Agency Announcement (BAA) Phase I efforts (NCTE; common fuel laser for small arms application; acoustic rifle system; microwave stun gun and FTA; explosively launched projectile; guided bullet; advanced materials and structures for small arms).               <ul style="list-style-type: none"> <li>- Initiated feasibility demonstration phase for follow-on FTA/NCTE efforts and delivered feasibility demonstration test plan.</li> <li>- Conducted market survey, reviewed concept proposals and evaluated technologies for non-toxic training ammunition.</li> </ul> </li> <li>• 382 - Initiated technology assessment for new personal and sniper weapons.               <ul style="list-style-type: none"> <li>- Developed strategy to continuously advance technology for Objective Family of Small Arms.</li> </ul> </li> </ul> <p>Total 4857</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3204 - Initiate integration of Objective Crew-Served Weapon (OCSW) sub-system components into demonstrator design.               <ul style="list-style-type: none"> <li>- Initiate subsystem technology investigations and front end analysis for an objective sniper weapon.</li> </ul> </li> <li>• 1193 - Fabricate hardware for FY 98 FTA/NCTE feasibility demonstrations.               <ul style="list-style-type: none"> <li>- Identify technologies for enhancement of Objective Family of Small Arms, focusing on individual and crew weapons.</li> <li>- Downselect to best initial technology concepts for non-toxic ammunition and perform concept verification.</li> </ul> </li> <li>• 100 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4497</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2517 - Complete integration of OCSW components into prototype weapon system.               <ul style="list-style-type: none"> <li>- Initiate integration of OICW fire control technology to OCSW to meet 2000 meter requirement.</li> </ul> </li> <li>• 972 - Complete front end analysis and trade-off determination for an objective sniper weapon.</li> <li>• 842 - Issue BAA and evaluate innovative concepts for enhancement of Objective Family of Small Arms and initiate competitive component development.</li> <li>• 455 - Complete FTA/NCTE feasibility demonstration phase and initiate application phase.</li> </ul> <p>Total 4786</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2715 - Complete OCSW fire control.               <ul style="list-style-type: none"> <li>- Initiate development of enhanced armor penetration (AP) round for OCSW.</li> </ul> </li> </ul> |  |                              |
| Project AH21  | Page 2 of 3 Pages                                | Exhibit R-2 (PE 0602623A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602623A Joint Service Small Arms Program</b> |                              |
|  | <b>PROJECT</b><br><b>AH21</b>  |                              |
| <ul style="list-style-type: none"> <li>• 1012 - Complete Blue Team review of sniper weapon analysis and initiate component design/demonstration for new sniper weapon.</li> <li>• 1477 - Complete initial component development of innovative concepts for enhancing the Objective Family of Small Arms</li> </ul> <p>Total 5204</p> |  |                              |
| <b>B. Project Change Summary</b>   |  |                              |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               |
|  | <u>FY 1998</u>   | <u>FY 1999</u>               |
| FY 1997 President's Budget   | 4975   | 4593                         |
| Appropriated Value   | 5114   | 4497                         |
| Adjustments to Appropriated Value  | -257   |                              |
| FY 1998 Pres Bud Request   | 4857   | 4497                         |
|  |  | 4786                         |
|  |  | 5204                         |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602624A Weapons and Munitions Technology</b> |                     |                           |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 24297             | 22246               | 25876               | 30613  | 31506               | 33119                     | 33793               | 34519                        | Continuing          | Continuing |
| AH18 Artillery & combat Support Technology   | 10073             | 9273                | 11067               | 12390  | 12871               | 13337                     | 13622               | 13918                        | Continuing          | Continuing |
| AH19 Close Combat Weaponry   | 7547              | 4933                | 6754                | 9384   | 9351                | 10164                     | 10353               | 10566                        | Continuing          | Continuing |
| AH28 Munitions Technology  | 6677              | 8040                | 8055                | 8571   | 9284                | 9618                      | 9818                | 10035                        | Continuing          | Continuing |
| AH36 Fuze Technology   | 0                 | 0                   | 0                   | 268  | 0                   | 0                         | 0                   | 0                            | 0                   | 268        |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> The objective of this Program Element (PE) is to develop affordable 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 to provide upgrade opportunities for fielded ground combat systems. The latter includes: precursor defeat of explosive reactive armor (ERA), advanced composite sabots, in-flight trajectory correction, smart barrel actuators/gearless gun drives, and modeling and analytic codes for thermal analysis and high impetus low flame temperature propellants to reduce wear on gun tubes (which degrades accuracy); high energy explosive technologies that increase projectile and warhead lethality; advanced armament fire control, and decision aids and software architecture; advanced acoustic sensor technology for smart systems, and supports technology advances in anti-armor mine warfare. This PE also funds several additional efforts, including: advanced gun propulsion technologies; shaped charge and explosively formed penetrator warheads and advanced materials for warhead liners and penetrators; advanced fuzes with emphasis on small volume, low cost and countermeasure resistance; area denial concepts; automatic loader and munition transfer mechanisms for large caliber weapons and storage devices; development of demonstration techniques in accordance with Army Battle Lab initiatives and wargame scenarios; and lightweight composite materials in mortar cartridge development. 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 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 (ARDEC), Picatinny Arsenal, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0602618A (Ballistics Technology), PE 0602623A (Joint Service Small Arms Program), and transitions to work performed in PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603607A (Joint Service Small Arms Program) and PE 0603802A (Weapons and Munitions Advanced Development). These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.</p> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| <i>Page 1 of 10 Pages</i>  |                   |                     |                     |  |                     | Exhibit R-2 (PE 0602624A) |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602624A Weapons and Munitions Technology</b> |                     |                           |                     | <b>PROJECT</b><br><b>AH18</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH18 Artillery & combat Support Technology   | 10073             | 9273                | 11067               | 12390  | 12871               | 13337                     | 13622               | 13918                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project focuses on the exploratory development of technology for cannon artillery, mortar weapon, fire control and combat support systems. This project funds technology to develop advanced acoustic sensors in support of the RFPI Advanced Concept Technology Demonstration (ACTD). Technology to improve combat vehicles' first round hit probability is being pursued through the development of "smart" barrel actuators and a gearless gun drive concept. Decision aid and software technology is being developed to increase armament battlefield survivability for self-propelled howitzers, along with technologies for improving the effectiveness and affordability of next generation smart munitions. Low Cost Competent Munition (LCCM) concepts integrating Global Positioning System (GPS), fuzing, and possibly guidance and control (G&amp;C) technology are being developed for artillery projectiles. The resulting screw-on module will significantly increase a projectile's overall delivery accuracy and also be readily applicable to the artillery's existing ammunition stockpile. An alternative radar-based projectile tracking system (PTS) is also being pursued. Technology for artillery projectile rotating and obturating bands is being pursued to address an impending shortcoming when firing from high performance cannons. The application of light-weight, high-strength composites to mortar projectiles is being pursued to extend range and, ultimately, enhance target effectiveness. This project also supports pulsed-power technology experiments for electric gun applications and the development and evaluation of advanced area denial concepts as an alternative to anti-personnel mining techniques.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1798 - Completed verification testing of self defense decision aid module; finalized reconnaissance, selection and occupation of position (RSOP) module for Crusader tactics, techniques and procedures (TTP) experiment; completed software tool development and defined viable reuse methods to reduce fire mission software cost and development time by 50%.             <ul style="list-style-type: none"> <li>- Completed M1A1 gearless turret gun drive (GTGD) designed and initiated fabrication study; completed design of 120mm M256 hybrid gun tube for smart barrel actuator integration and test; defined GTGD power consumption characteristics to determine battery power consumption during Silent Watch status.</li> <li>- Defined, through simulation, the optimum configuration of the electric gun and power supply in the Future Combat System (FCS); maintained core research capability in electric gun pulsed power technology.</li> </ul> </li> <li>• 2172 - Refined advanced acoustic sensor (AAS) target vehicle classifier algorithms for integration in the intelligent minefield (IMF); completed AAS miniaturization of prototype hardware in support of the RFPI ACTD.             <ul style="list-style-type: none"> <li>- Provided technical support to the RFPI integrated acoustic sensor (IAS) development and internetted unattended ground sensor (IUGS), successfully tested innovative acoustic wind noise cancellation technique for vehicle application.</li> </ul> </li> <li>• 2283 - Completed mortar fire control system (MFCS) participation in Warrior Focus Advanced Warfighting Experiment (AWE) at Ft. Polk, demonstrating fire mission response times of 1.5 minutes vs. the current six minute standard.</li> </ul> |                   |                     |                     |  |                     |                           |                     |                               |                     |            |
| Project AH18   |                   |                     | Page 2 of 10 Pages  |  |                     | Exhibit R-2 (PE 0602624A) |                     |                               |                     |            |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602624A Weapons and Munitions Technology</b>   | PROJECT<br><b>AH18</b>       |
| <b>FY 1996 Accomplishments (continued)</b>                     |   |                              |
|  | <ul style="list-style-type: none"> <li>- Refined fuzing, payload expulsion and rocket motor designs, and conducted interior ballistic and trajectory analyses for 120mm composite dual purpose improved conventional munition (DPICM) mortar cartridge</li> <li>- Successfully tested two new composite burster tube materials at 13,000 Gs; gun-fired five high capacity projectile (HICAP) prototypes at Yuma Proving Ground, confirming range predictions and component survivability; finalized obturator design to address projectile body engraving in worn 52 caliber or longer gun tubes; initiated rotating band computer simulations.</li> </ul>  |                              |
| • 3820   | <ul style="list-style-type: none"> <li>- Conducted LCCM Phase-1 open-loop canard test at Yuma Proving Ground with successful roll-stabilization; initiated canard and battery re-design for Phase-2; initiated hi-G micro-electro mechanical systems (MEMS) accelerometer study.</li> <li>- Tracked 155mm projectile trajectories to 24km range/50,000 feet altitude and predicted impact to within ten meters utilizing radar-based projectile tracking system (PTS) at Yuma Proving Ground.</li> </ul>  |                              |
| Total  | 10073   |                              |
| <b>FY 1997 Planned Program:</b>                                |   |                              |
| • 2272   | <ul style="list-style-type: none"> <li>- Conduct cannon/projectile compatibility Phase I test firing and conduct post-mortem performance evaluation; modify obturator design and fine tune material characteristics.</li> <li>- Complete gearless gun drive and smart barrel actuator design; fabricate hybrid M256 gun tube.</li> <li>- Define operational concepts and conduct a requirements feasibility and trade-off analysis of applying software and hardware decision aids components to future armament systems on the digitized battlefield; integrate baseline software architecture description tool into a software test bed and demonstrate the ability to cost effectively support software code development for weapon systems.</li> </ul>                                |                              |
| • 4651   | <ul style="list-style-type: none"> <li>- Complete auto-registration LCCM GPS translator assembly and test firings; complete projectile impact prediction algorithms; support Advanced Concepts Technology Program (ACT II) closed-loop flight test.</li> <li>- Refine projectile tracking system (PTS) meteorological extraction algorithms to enable accurate predicted-fire engagements of subsequent missions.</li> <li>- Continue support of Focused Technology Program (FTP) and Army Research Laboratory efforts in electric armaments planning, management and execution.</li> <li>- Support Warfighting Experiments between ARDEC and Field Artillery School, Ft. Sill, examining potential First Round Effects on Target concepts to improve artillery effectiveness.</li> </ul> |                              |
| • 2350   | <ul style="list-style-type: none"> <li>- Demonstrate noise cancellation techniques for vehicle mounted acoustic system and continue support to RFPI ACTD.</li> <li>- Conduct an area intruder detection study using existing sensor nets and define performance parameters; develop the baseline unmanned terrain domination concept as an alternative to conventional anti-personnel mining techniques.</li> <li>- Define power, data rate and producibility requirements to increase footprint and detection range of a low cost 2nd generation, direct diode laser radar (LADAR) sensor.</li> </ul>  |                              |
| Project AH18   | Page 3 of 10 Pages  | Exhibit R-2 (PE 0602624A)    |

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|--|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602624A Weapons and Munitions Technology</b> | PROJECT<br><b>AH18</b>  |
| <b>FY 1997 Planned Program: (continued)</b>  |   |   |
| <ul style="list-style-type: none"> <li>- Initiate fabrication of prototype fuzing, payload expulsion and rocket motor for the 120mm extended range (ER) mortar cartridge.</li> <li>- Collect target acoustic signature data to develop/enhance commander's tactical decision aids in support of integrated acoustic system (RFPI ACTD residual hardware).</li> </ul> |   |   |
| Total  | 9273  |   |
| <b>FY 1998 Planned Program:</b>  |   |   |
| •  | 4724  | <ul style="list-style-type: none"> <li>- Conduct system demonstration of auto-registration concept.</li> <li>- Conduct closed-loop flight testing of LCCM self-correcting guidance concepts; dynamically test guidance mechanisms with GPS; flight test gun-hardened GPS components; evaluate MEMS technology for smart munition applications.</li> <li>- Perform projectile tracking system (PTS) operational demonstration and define performance specification.</li> <li>- Evaluate a deployment version of the area denial concept as an alternative to conventional mining techniques; test alternate sensor technologies for personnel detection in realistic environments and lethal and non-lethal defeat mechanisms.</li> </ul>  |
| •  | 3255  | <ul style="list-style-type: none"> <li>- Integrate gearless turret drive, smart barrel system, and gearless commander's weapon station (CWS) into M1A1 testbed; complete fabrication of gearless main gun drive; initiate dynamic testing of full-scale smart barrel actuators.</li> <li>- Develop baseline reference architecture software specification for weapon systems; draft architecture process guidelines and baseline reuse components; use software testbed to evaluate the processing of architectures and software component technologies.</li> <li>- Conduct final gun testing of high performance rotating band and obturator designs under worse case conditions (worn-tubes, maximum muzzle velocity); evaluate design performance.</li> <li>- Continue support of RFPI acoustic sensor effort; enhance baseline design of battlefield combat ID (BCID) acoustic sensor system; continue development of acoustic sensor emplacement tools.</li> <li>- Implement/demonstrate on-vehicle acoustic system(s) for counter-fire, counter-sniper and/or situation awareness.</li> </ul> |
| •  | 3088  | <ul style="list-style-type: none"> <li>- Initiate knowledge base and rule development of decision aids utilizing digitized battlefield plans and procedures; initiate integration of the route planning and site selection decision aid modules into the distributed interactive simulation (DIS) environment for the Division Task Force XXI Advanced Warfighting Experiment (AWE).</li> <li>- Conduct simulations in support of Battle Lab AWEs and ARDEC RFPI programs (e.g., intelligent minefield (IMF), precision guided mortar munition (PGMM), and the extended range mortar).</li> <li>- Complete extended range mortar rocket, fuzing and payload deployment designs; complete fabrication of demo hardware and conduct live firing to prove-out rocket motor and payload deployment.</li> <li>- Conduct electric gun technology maturation assessment for program re-transition decision; review/update Future Combat System (FCS) main armament system acquisition strategy.</li> </ul>   |
| Total  | 11067   |   |
| Project AH18   | <i>Page 4 of 10 Pages</i>   | Exhibit R-2 (PE 0602624A)   |

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0602624A Weapons and Munitions Technology</b> | <b>PROJECT</b><br><b>AH18</b> |
|---|--|-------------------------------|

**FY 1999 Planned Program:**

- 5375 - Integrate miniaturized guidance and control (G&C) system hardware into LCCM self-correcting concept.
  - Demonstrate LCCM self-correcting mechanism with GPS utilizing reduced fuze volume; gun fire 155mm projectile to demonstrate MEMS technology survivability and fuzing potential.
  - Gather area denial intrusion sensor data in various terrain and weather conditions; develop computer algorithms; conduct simulation to evaluate operational effectiveness.
- 3440 - Continue integration of gearless gun drive into M1A1 testbed; conduct weapon stabilization tests at Aberdeen Proving Ground; transition M1A1 technology to advanced development in support of the Direct Fire Lethality ATD.
  - Develop process tools to support a "software component factory" approach to affordable embedded software development; develop repository of reusable fire mission components.
  - Conduct demonstration of battlefield combat ID (BCID) acoustic sensor system; conduct demonstration of acoustic sensor emplacement tools for battlefield commanders.
  - Fabricate brassboard extended range mortar fuze device and gun fire to demonstrate survivability and functioning.
- 3575 - Complete capture of armament decision aid knowledge base; complete hardware, software and DIS integration efforts; test and verify operation of new decision aid components; initiate man-in-the-loop testing.
  - Conduct simulations in support of Battle Lab AWEs and ARDEC RFPI programs (e.g., MOUT, IMF, 105mm TGP, Area Denial).
  - Define lightweight mortar design parameters and optimum material candidates; initiate design of key components.

Total 12390

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 11001          | 9484           | 11012          | 11894          |
| Appropriated Value                | 11332          | 9273           |                |                |
| Adjustments to Appropriated Value | -1259          |                |                |                |
| FY 1998 Pres Bud Request          | 10073          | 9273           | 11067          | 12390          |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602624A Weapons and Munitions Technology</b> |                     |                     |                           | PROJECT<br><b>AH19</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AH19 Close Combat Weaponry  | 7547              | 4933                | 6754                | 9384  | 9351                | 10164               | 10353                     | 10566                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> The objective of this project is to exploit and advance new technologies which will demonstrate significant improvements in direct fire weapon performance for ground and air combat vehicles. Principal efforts support the Direct Fire Lethality Program. Included are technologies for the tank projectile precursor defeat of explosive reactive armor (ERA), composites for sabots and gun structures, and trajectory correction mechanisms. In addition, this project develops technologies in the areas of weapon stabilization, projectile design and fabrication, means to increase gun life by reducing barrel wear, thermal management of high rate launch mechanisms and munition auto-loaders, feeders and storage mechanisms. 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. For FY 1996 only, this project also supported the DoD Non Lethal Munitions program.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 7547 - Gun launched prototype kinetic energy (KE) precursor projectile and tested for structure and function and aerodynamic performance.</li> <li>- Completed structure tests of an enhanced-accuracy kinetic energy projectile.</li> <li>- Conducted acoustic device demonstration; demonstrated ballistic net from 40mm M203 grenade launcher; initiated 40mm non-lethal munitions program; drafted performance specification for 40mm blunt impact munitions; initiated non-lethal vehicle immobilizer and area denial entanglement systems; completed evaluation of non-developmental item muzzle launched ordnance for M16</li> <li>- Completed compact (same stowage as Abrams tank) 120mm autoloader.</li> </ul> <p>Total 7547</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3740 - Complete KE precursor and axial thruster component prove-out and transition to cartridge integration phase (PE 0603004A/Proj D232).</li> <li>- Deliver compact autoloader for the PM-Abrams integration demonstration.</li> <li>- Apply plasma sputtered deposit of molybdenum/rhenium to worn M256 120mm tank gun tubes and evaluate for barrel life extension.</li> <li>- Apply composite material gun tubes and components to mortar and munition applications.</li> <li>• 1162 - Initiate acoustic lab demonstration to assess novel target effects for landmine applications (electric and combustion driven sources), continue bio-effects study and testing.</li> <li>- Demonstrate a pre-emplaced, remotely activated, vehicle arresting barrier capable of stopping a wheeled vehicle moving at 48 mph.</li> <li>• 31 - Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4933</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project AH19  |                   |                     | Page 6 of 10 Pages  |   |                     |                     | Exhibit R-2 (PE 0602624A) |                              |                     |            |



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|---|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602624A Weapons and Munitions Technology</b> | PROJECT<br><b>AH19</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6254 - Initiate advanced light gun/ammunition technology improvements for aviation and ground combat vehicles.             <ul style="list-style-type: none"> <li>- Design and evaluate novel penetrators to defeat advanced armors.</li> <li>- Conduct system level trade-offs for target defeat (direct fire and non line of sight)</li> </ul> </li> <li>• 500 - Evaluate plasma deposition of molybdenum/rhenium alloy coatings to refurbish worn tank cannon barrels.</li> </ul> <p>Total 6754</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 8884 - Fabricate and test advanced novel penetrator designs.             <ul style="list-style-type: none"> <li>- Develop an ammunition upgrade design concept to meet longer range requirements.</li> <li>- Use distributed interactive simulation to determine overall system performance requirements for dual role air-to-air/air-to-ground weapon system.</li> <li>- Fabricate and demonstrate new method(s) to defeat explosive reactive armor.</li> </ul> </li> <li>• 500 - Determine relationships between barrel wear and combustion gas components; adapt unified code to predict wear and erosion of candidate barrel liners and coatings.</li> </ul> <p>Total 9384</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 15%; text-align: center;"><u>FY 1996</u></th> <th style="width: 15%; text-align: center;"><u>FY 1997</u></th> <th style="width: 15%; text-align: center;"><u>FY 1998</u></th> <th style="width: 15%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4919</td> <td style="text-align: center;">5389</td> <td style="text-align: center;">7330</td> <td style="text-align: center;">8890</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5057</td> <td style="text-align: center;">4933</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+2490</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">7547</td> <td style="text-align: center;">4933</td> <td style="text-align: center;">6754</td> <td style="text-align: center;">9384</td> </tr> </tbody> </table> <p>Change Summary Explanation:</p> <p style="padding-left: 40px;">Funding: FY 1996 funds increased (+2200) for DoD Non Lethal Weapons program.<br/>         FY 1999 funds increased (+500) for technology to reduce gun wear and erosion.</p> |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4919 | 5389 | 7330 | 8890 | Appropriated Value | 5057 | 4933 |  |  | Adjustments to Appropriated Value | +2490 |  |  |  | FY 1998 Pres Bud Request | 7547 | 4933 | 6754 | 9384 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 4919  | 5389                         | 7330           | 8890           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 5057  | 4933                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | +2490   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 7547  | 4933                         | 6754           | 9384           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |
| Project AH19  | Page 7 of 10 Pages  | Exhibit R-2 (PE 0602624A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |       |  |  |  |                          |      |      |      |      |

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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602624A Weapons and Munitions Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>AH28</b> |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH28 Munitions Technology  | 6677              | 8040                | 8055                | 8571   | 9284                | 9618                | 9818                      | 10035                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project supports advanced technologies in gun propellants, explosives, warheads, insensitive munitions (IM) and materials for armor 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 are needed to increase lethality. New, improved energetic materials have numerous transition opportunities for weapons system upgrades. The IM efforts conducted in this project will increase the survivability of tanks, artillery, helicopters and infantry fighting vehicles, as well as safety in manufacturing plants, storage depots, and air and sea transport.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2242 - Conducted sensitivity/performance tests and developed process for CL-20 explosive/Trinitroazetadine (TNAZ) formulations.<br/>- Developed pilot lot process technology for TNAZ explosives and synthesized more highly nitrated cubane explosives.</li> <li>• 2122 - Demonstrated advanced EFP anti-armor warhead designs and developed concrete defeat mechanism.</li> <li>• 668 - Tested first generation of advanced tungsten composite penetrators (a more environmentally friendly replacement for depleted uranium (DU)).</li> <li>• 1645 - Initiated small scale evaluation of high energy gun propellant composition for advanced KE cartridge.</li> </ul> <p>Total 6677</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2592 - Conduct warhead testing with advanced CL-20/TNAZ formulations.<br/>- Demonstrate polynitrocubane synthesis and transition TNAZ for pilot plant processing.</li> <li>• 2786 - Demonstrate a high efficiency lightweight concrete defeating warhead.</li> <li>• 721 - Initiate 1/4 scale testing of tungsten composite penetrators (a more environmentally friendly replacement for DU in penetrators)</li> <li>• 1900 - Scale up pilot plant processing technology of high energy gun propellant.</li> <li>• 41 - Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 8040</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2611 - Scale up polynitrocubane explosive to pilot plant quantity and initiate study for anti-armor warhead loading.</li> <li>• 2950 - Demonstrate selective warhead design to defeat heavy armored targets (15-20% increase in performance over state-of-the-art warheads) or lightly armored targets (four fold increase in lethal area over current shaped charges).</li> </ul> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |
| Project AH28   |                   |                     | Page 8 of 10 Pages  |  |                     |                     | Exhibit R-2 (PE 0602624A) |                               |                     |            |

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|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602624A Weapons and Munitions Technology</b> |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|   |  | <b>PROJECT</b><br><b>AH28</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program (continued):</b></p> <ul style="list-style-type: none"> <li>• 763 - Complete ¼ scale testing and initiate process scale up for full scale technology demonstration of tungsten penetrators.</li> <li>• 1731 - Demonstrate high energy high performance gun propellant in live firings (impetus values 10-20% over JA2 and muzzle velocities 5-10% over M829A2).</li> </ul> <p>Total 8055</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2950 - Conduct static warhead test using polynitrocubane explosive to show an increase in energy performance of up to 25%.</li> <li>• 3000 - Build on warhead designs demonstrated in FY 1998 to develop advanced warhead concepts to defeat the 21st century threat.</li> <li>• 863 - Demonstrate full scale tungsten penetrators.</li> <li>• 1758 - Conduct studies on the processibility of thermoplastic elastomers in a twin screw extruder and the effect of binder/plasticizer type and ratio on energetic materials.</li> </ul> <p>Total 8571</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">7375</td> <td style="text-align: center;">8214</td> <td style="text-align: center;">8588</td> <td style="text-align: center;">9423</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">7579</td> <td style="text-align: center;">8040</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-902</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">6677</td> <td style="text-align: center;">8040</td> <td style="text-align: center;">8055</td> <td style="text-align: center;">8571</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 7375 | 8214 | 8588 | 9423 | Appropriated Value | 7579 | 8040 |  |  | Adjustments to Appropriated Value | -902 |  |  |  | FY 1998 Pres Bud Request | 6677 | 8040 | 8055 | 8571 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 7375   | 8214                          | 8588           | 9423           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 7579   | 8040                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -902   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 6677   | 8040                          | 8055           | 8571           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|--|--|--|--|-----------------------------------|--|--|--|--|--------------------------|---|---|---|-----|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602624A Weapons and Munitions Technology</b> |                     |                     |                           | PROJECT<br><b>AH36</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| AH36 Fuze Technology   | 0                 | 0                   | 0                   | 268   | 0                   | 0                   | 0                         | 0                            | 0                   | 268        |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project focuses on the applied research of innovative fuzing technologies for ammunition in advanced direct and indirect fire weapons. Fuzing technologies will be investigated that provide the capability to optimize warhead performance and increase lethality against a variety of targets with known and evolving threats, including high performance weapon systems, reactive and active armor, and electronic countermeasures. The principal effort is fuze target sensors. Included in fuze target sensors is the investigation of advanced sensor concepts for proximity fuze applications to include microwave, millimeter wave and laser detection and ranging (LADAR) technologies with emphasis on small volume, low cost designs. This effort will enable the successful launch of a kinetic energy precursor from a tank projectile for defeat of explosively reactive armor. Spin-offs from this exploratory development include fuzing for artillery, mortars, Navy guns, and Air Force high-explosive bombs.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 268 - Design and test candidate LADAR signal processing algorithms.</li> <li style="padding-left: 20px;">- Assemble and test breadboard LADAR fuze.</li> <li style="padding-left: 20px;">- Investigate candidate millimeter wave front ends.</li> </ul> <p>Total 268</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">268</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: Project established with FY 1999 funds (+268) to focus efforts on advanced fuze technology research.</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value |  |  |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 0 | 0 | 268 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| FY 1997 President's Budget   | 0                 | 0                   | 0                   | 0   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| Appropriated Value   |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| Adjustments to Appropriated Value  |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| FY 1998 Pres Bud Request   | 0                 | 0                   | 0                   | 268   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |
| Project AH36   |                   |                     | Page 10 of 10 Pages |   |                     |                     | Exhibit R-2 (PE 0602624A) |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |  |  |  |                                   |  |  |  |  |                          |   |   |   |     |

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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602705A Electronics and Electronic Devices</b> |                     |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 21134             | 24351               | 20192               | 22374  | 23615               | 26305               | 26543               | 26837                        | Continuing          | Continuing |
| AH11 Battery/Individual Power Technologies   | 4266              | 5946                | 2218                | 2415   | 2404                | 2488                | 2537                | 2593                         | Continuing          | Continuing |
| AH94 Electronics and Electronic Devices  | 16868             | 18405               | 17974               | 19959  | 21211               | 23817               | 24006               | 24244                        | Continuing          | Continuing |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> This program consists of research in the physical sciences essential to all land combat systems that contain electronics, chemical/biological sensors, photonics, magnetic materials, ferroelectrics, microwave and millimeter-wave components, batteries, and fuel cells. Supported systems include the Future Soldier System (FSS), autonomous missile systems, advanced land combat vehicles, smart anti-tank munitions, electric weapons, secure jam-resistant communication, automatic target recognition (ATR), foliage-penetrating radar, combat identification, and digitizing of the battlefield. The work under this program element provides enabling capability to perform precision deep fires against critical mobile and fixed targets, to provide exceptional all-weather, day or night, theater air defense against advanced enemy missiles and aircraft, and to develop 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 all of the science and technology thrust areas that employ electronic and portable power-source technology. This PE includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2.</p> |                   |                     |                     |  |                     |                     |                     |                              |                     |            |

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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602705A Electronics and Electronic Devices</b> |                     |                           |                     | <b>PROJECT</b><br><b>AH11</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH11 Battery/Individual Power Technologies  | 4266              | 5946                | 2218                | 2415   | 2404                | 2488                      | 2537                | 2593                          | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides exploratory development in the application of the physical sciences of electrochemistry, electronics, and process science, as they apply to improving existing systems and enabling newer, more advanced battery, fuel cell, and electromechanical (including engines and permanent magnetic alternators) technologies. The goal is to develop small, low-cost, environmentally compatible, light weight, high energy density sources of power for communications, target acquisition, miniaturized displays and combat service support applications, as well as for microclimatic cooling for the Future Soldier System. Technology developments support thrusts aimed at reduced acquisition costs, reduced operations and support costs, and Army modernization. Mobile electric power and fuel cell technology efforts conducted under PE 0602786A/Project AH20 in prior years is restructured to this project beginning in FY 1997. Battery technology conducted under Project AH94 is restructured to this project in FY 1997.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2766 - Developed ultra-safe, high performance, rechargeable lithium-ion batteries containing no free metallic lithium.             <ul style="list-style-type: none"> <li>- Continued development of low cost, high energy, rechargeable alkaline military batteries.</li> <li>- Continued development of very high energy density, ultra-safe zinc-air batteries.</li> </ul> </li> <li>• 1500 - Tested and evaluated a range of commercial battery chargers/maintainers for extending battery cycle life.</li> </ul> <p>Total 4266</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 895 - Complete design and development of rechargeable lithium ion BA-2590 battery and charger, based on small commercially available cells.             <ul style="list-style-type: none"> <li>- Demonstrate prototype capacitor-battery hybrid power source for low cost Simulated Area Weapons Effects (SAWE)/Multi Integrated Laser Engagement System (MILES) training missions.</li> <li>- Continue development of man-portable, hydrocarbon-fueled thermophoto-voltaic power source system.</li> </ul> </li> <li>• 166 - Complete design and fabricate/test essential controls/conditioning/cooling subsystems leading to a complete multi-fuel burning 6 hp engine subsystem. Design/fabricate/test an interim control subsystem for a 3 kW 120 VAC, 60 Hz engine driven generator set. Design/fabricate signature suppressed housing. The design shall include thermal management and user interface considerations.</li> <li>• 935 - Reduce size and weight of fuel cells, improve thermal management and hydrogen generation techniques.</li> <li>• 705 - Perform feasibility assessment tasks to demonstrate silent, portable fuel cell systems as a smart battery recharger/power source which can be used by dismounted soldier.</li> <li>• 1000 - Build, test, demonstrate prototype zinc-air military batteries.</li> <li>• 750 - Build and test rechargeable alkaline zinc batteries in standard military battery configurations.</li> </ul> |                   |                     |                     |  |                     |                           |                     |                               |                     |            |
| Project AH11  |                   |                     | Page 2 of 8 Pages   |  |                     | Exhibit R-2 (PE 0602705A) |                     |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602705A Electronics and Electronic Devices</b> | <b>PROJECT</b><br><b>AH11</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1997 Planned Program (Continued):</b></p> <ul style="list-style-type: none"> <li>• 600 - Continue investigation of effects of no lead added on performance of alkaline cells.</li> <li>• 750 - Complete development of safe, non metallic lithium rechargeable Fat-D cell for optimum performance BA-2590 training battery.</li> <li>• 145 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5946</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 940 - Complete development of standard family of lithium manganese dioxide batteries as a more cost effective alternative to the present nonrechargeable lithium sulfur dioxide system for combat missions.</li> <li>• - Complete development of safe, optimized-performance standard family of rechargeable lithium ion batteries as a lighter weight, lower operations and support cost alternative to the present nickel cadmium and nickel metal hydride batteries.</li> <li>• - Design and demonstrate a proof-of-principle portable field battery charger based on hydrocarbon fueled thermophoto-voltaic power source system.</li> <li>• 339 - Complete testing of and demonstrate the lightweight, man portable, signature suppressed, electronically controlled 3.0kW, 120 VAC, 60 Hz engine driven generator set starting/operating on multiple fuels.</li> <li>• 939 - Demonstrate improved lightweight 50 and 150 watt fuel cell systems with 600 watt-hour capacity.</li> </ul> <p>Total 2218</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1244 - Complete development of an ultra high energy density, low operations and support cost nonrechargeable zinc-air battery system.</li> <li>• - Fabricate and field test prototype thermophoto-voltaic field battery chargers/portable power sources.</li> <li>• - Continue design, application, engineering and testing of hybrid power sources to provide smaller, lighter and more cost effective man-portable power systems for C4IEW equipment.</li> <li>• 528 - Initiate design of a 350 pound portable, electronically controlled engine-driven generator set capable of providing 5 kW 120 VAC, 60 Hz and operating on multiple fuels for tactically mobile use. Initiate fabrication/procurement of the power components and subsystems.</li> <li>• 643 - Design liquid fueled 50 - 150 watt fuel cell with 2000 watt-hour.</li> </ul> <p>Total 2415</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2877</td> <td style="text-align: center;">2123</td> <td style="text-align: center;">2271</td> <td style="text-align: center;">1887</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4500</td> <td style="text-align: center;">5946</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-234</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4266</td> <td style="text-align: center;">5946</td> <td style="text-align: center;">2218</td> <td style="text-align: center;">2415</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2877 | 2123 | 2271 | 1887 | Appropriated Value | 4500 | 5946 |  |  | Adjustments to Appropriated Value | -234 |  |  |  | FY 1998 Pres Bud Request | 4266 | 5946 | 2218 | 2415 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 2877   | 2123                          | 2271           | 1887           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 4500   | 5946                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -234   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 4266   | 5946                          | 2218           | 2415           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AH11  |  | Exhibit R-2 (PE 0602705A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |  | DATE                      |
|---|--|---------------------------|
| BUDGET ACTIVITY   | PE NUMBER AND TITLE                                | PROJECT                   |
| <b>2 - Applied Research</b>   | <b>0602705A Electronics and Electronic Devices</b> | <b>AH11</b>               |
| <p>Change Summary Explanation: Funding: FY 1996: Congressional interest add to evaluate/test a charger/maintainer capability to extend battery cycle life.<br/>FY 1997: Congressional interest add (+3950) to evaluate additional battery and fuel cell technologies.<br/>FY 1999: Project funding increased (+520) to fund advanced lightweight portable power system, a science and technology objective.</p> |  |                           |
| Project AH11  | Page 4 of 8 Pages                                  | Exhibit R-2 (PE 0602705A) |



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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |                |                  |                   |   |                  |                  |                           | DATE<br>February 1997  |                  |            |
|--|----------------|------------------|-------------------|---|------------------|------------------|---------------------------|------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                |                  |                   | PE NUMBER AND TITLE<br><b>0602705A Electronics and Electronic Devices</b> |                  |                  |                           | PROJECT<br><b>AH94</b> |                  |            |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate  | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate       | Cost to Complete | Total Cost |
| AH94 Electronics and Electronic Devices  | 16868          | 18405            | 17974             | 19959   | 21211            | 23817            | 24006                     | 24244                  | Continuing       | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 8337 - Demonstrated an electronic component design tool featuring a behavioral accelerator for architectural assessment/optimization. Investigated integration of microwave (MW)/analog/digital design tools into a single hardware description language (HDL).<br/>                     - Designed and fabricated advanced microwave/millimeter microwave components to enable line of sight space and terrestrial communications, Battlefield Combat Identification System for the dismounted soldier, and moving target indicator (MTI) radar Advanced Technology Demonstration. Developed sub-millimeter wave (MMW)/terahertz components to enable comms devices operating at frequencies where detection, interference, and countermeasures are inhibited.<br/>                     - Designed and fabricated 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.</li> <li>• 5686 - Exploited improved processing technologies to fabricate miniature sensors/actuators for mine detection, hand-held optoelectronic biosensors, and missile seekers. Developed a biochemical sensor system to determine the feasibility of coupling mechanisms critical to biosensor development.<br/>                     - Improved fabrication processes based on phosphor physics and luminescence properties to develop and demonstrate ruggedized, high resolution, low power, flat panel and head-mounted displays for command post situations, personal communications, and training applications. Investigated reliability issues and commercial practices.<br/>                     - Synthesized/evaluated novel fluorinated carbon cathode material for future primary lithium battery with energy density greater than 200 Whr/kg; developed high energy/power density LiMnO2 pouch battery for the 21st Century Land warrior (21CLW).</li> <li>• 2845 - Demonstrated low temperature heteroepitaxial growth for circuit integration; continued modeling of nonlinear optical processes for optical oscillators/amplifiers and improvement of zinc germanium phosphide material.<br/>                     - Demonstrated a massively parallel, scaleable processor in an architecture of sufficient throughput to support real-time 3-D visualization of terrain and battlefield information across distributed computing environments.</li> </ul> <p>Total 16868</p> |                |                  |                   |   |                  |                  |                           |                        |                  |            |
| Project AH94   |                |                  | Page 5 of 8 Pages |   |                  |                  | Exhibit R-2 (PE 0602705A) |                        |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |   | DATE<br><b>February 1997</b> |
|--|---|------------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE   | PROJECT                      |
| <b>2 - Applied Research</b>                                    | <b>0602705A Electronics and Electronic Devices</b>  | <b>AH94</b>                  |
| <b>FY 1997 Planned Program:</b>                                |   |                              |
| • 10125  | - Improve integrated computer-aided design technologies and apply to electronic components to achieve a 4x reduction in time and cost to develop/upgrade high performance devices, components, sensors and process modules for Army land combat systems.<br>- Continue effort to design and fabricate advanced MW/MMW/quasi-optical components to improve line-of-sight space and terrestrial communication and fire control applications. Design and prototype sub-MMW/terahertz components to enable communication devices to operate at frequencies where detection, interference, and countermeasures are inhibited.<br>- Develop and characterize new piezoelectric materials and novel resonators and microresonators for low noise oscillators and high-accuracy clock applications. Develop high-accuracy, low-noise, low-power quartz and atomic clocks and resonant sensors for uncooled infrared, chemical and acceleration sensing. |                              |
| • 3882   | - Design, fabricate, and transition improved miniature sensors/actuators for mine detection and missile seekers. Develop hand-held optoelectronic biosensors to provide new and critically needed capabilities in biological/chemical warfare agent detection for the warfighter.<br>- Apply improved fabrication processes based on phosphor physics and luminescence properties to emerging display technologies and demonstrate ruggedized, high resolution, low power, flat panel displays for command post situations, personnel communications, and training applications.<br>- Jointly evaluate with Air Force high temperature super conducting (HTSC) antenna feed for Military Strategic Tactical Relay System (MILSTAR); demonstrate and integrate MMW devices into MTI radar.   |                              |
| • 4225   | - Prototype lithium cells utilizing highly energetic oxyhalide and transition metal oxide cathode materials; demonstrate proof-of-principle thermophotovoltaic power source for quiet mobile electric power field generators.<br>- Continue investigation of nonlinear optical processes; investigate additional materials; extend modeling of nonlinear processes; optimize mid-IR optical parametric oscillator (OPO).<br>- Develop a prototype to validate scalability of processors and architectures from combat platforms to mobile command nodes. Transition technology to Battlespace C2 ATD.   |                              |
| 173  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                              |
| Total  | 18405   |                              |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| • 5180   | -Fabricate and evaluate ferroelectric thin-film millimeter wave scanning antenna and advanced ferroelectric lenses to demonstrate electronic scanning.<br>-Demonstrate MW/MMW/terahertz devices for communications/navigation/surveillance systems.<br>-Develop predictive physics-based and circuit-based modeling and simulation tools for microwave circuits, leveraging high performance computing assets.<br>-Develop a bio-acoustic wave sensor based on binding reactions to detect toxic protein, viruses, and bacteria.  |                              |
| Project AH94   | Page 6 of 8 Pages   | Exhibit R-2 (PE 0602705A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602705A Electronics and Electronic Devices</b>  | PROJECT<br><b>AH94</b>       |
| <b>FY 1998 Planned Program: (continued)</b>                    |  |                              |
| • 6133   | -Design and fabricate optoelectronic devices for secure, spread spectrum communications systems and high efficiency power switches for use in foliage/ground penetrating ultra-wide band radar applications.<br>-Complete material property studies and optimize process technology for lead zirconate titanate (PZT) thin-films for use in microactuators and microsensor devices.<br>-Develop high luminous efficacy phosphors and devices, circuitry and drivers for various display technologies, and perform characterization of these displays.  |                              |
| • 3234   | -Execute DoD-mandated program to maintain industrial base in oscillator and clock technology.<br>-Develop low-noise, acceleration-insensitive oscillator technology for air-borne navigation and communication systems such as J-STARS.<br>-Develop low-power, high-accuracy clock technology to support direct P-code acquisition of global positioning system (GPS) as well as a high-shock version for GPS guided munitions.  |                              |
| • 1459   | -Leverage DARPA funded program to develop a 20kW, 500kJ 144V prototype capacitor. Continue efforts to improve technology for lightweight hydrogen and methanol fueled backpack fuel cell.<br>-Investigate new cathodic electrocatalysts for man-portable methanol fuel cells and prototype rechargeable Li cells with solid electrolyte to develop low-cost, high-energy density power sources.<br>-Improve the design and construction of reserve battery technology and demonstrate the feasibility of a 90 second operating lifetime.   |                              |
| • 702  | -Investigate techniques to parallelize algorithms for transformation and rendering the information elements that are part of the battle scene which will be compatible with the next generation of tactical parallel and scalable processing architectures.  |                              |
| • 1266   | -Fabricate mercury cadmium telluride detector array on silicon substrate.<br>-Demonstrate 8 micron laser source by OPO and characterize parameters relevant for remote chemical detection.   |                              |
| Total  | 17974  |                              |
| <b>FY 1999 Planned Program:</b>                                |  |                              |
| • 4890   | -Design and fabricate high frequency electronic components including antennas, ferroelectric materials/devices, transmit/receive modules, and MW/MMW devices to improve soldier situational awareness by enhancing the senses through communications, radar, electronic warfare (EW), surveillance, and target acquisition systems.<br>-Develop scalable software to predict performance, cost, and other parameters of electronic components without producing hardware.<br>-Demonstrate simulation models for power semiconductors, HDL, and electromagnetic solvers for high frequency circuit design to reduce procurement time and costs of high frequency electronic components. |                              |
| • 4318   | -Execute DoD-mandated program to support industrial base for research on low-noise, acceleration-insensitive oscillator technology and low-power, high-accuracy, high-shock clocks for communication/navigation systems.   |                              |
| Project AH94   | Page 7 of 8 Pages  | Exhibit R-2 (PE 0602705A)    |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b> | PE NUMBER AND TITLE<br><b>0602705A Electronics and Electronic Devices</b> | PROJECT<br><b>AH94</b> |
|--|---|------------------------|

**FY 1999 Planned Program: (continued)**

- 6981 -Advance the state-of-the-art of GaAs quantum well technology to support manufacturable, low-cost, high-performance devices for missile seeker applications.  
-Continue to improve optoelectronic device design, fabrication, and characterization processes for high speed communications and target acquisition/surveillance.  
-Leverage DARPA programs to continue advanced displays research on phosphors, interface circuitry, and manufacturing processes to eventually achieve luminous efficacy of 80 lumens/Watt.  
-Develop a tapered fiber-optic biosensor based on fluorescent evanescent wave detection to target toxic small and large molecules and particles (endotoxins, oligonucleotides, viruses, cells, and fragments).
  - 1695 -Research and develop electrode and electrolyte materials to enable advanced energy storage devices and electrochemical capacitors for portable communications systems.  
-Continue to improve reserve technology for smaller, longer-lived, higher power-density devices capable of surviving high-spin, high “g” environments for smart mines and fuses.
  - 730 -Demonstrate a parallelized battlespace visualization suit of algorithms on a next generation tactical processing architecture.
  - 1345 -Demonstrate high quality electro-optic devices monolithically integrated with silicon electronic devices.
- Total      19959

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President’s Budget        | 17051          | 18799          | 19207          | 21940          |
| Appropriated Value                | 17525          | 18405          |                |                |
| Adjustments to Appropriated Value | -657           |                |                |                |
| FY 1998 Pres Bud Request          | 16868          | 18405          | 17974          | 19959          |

Change Summary Explanation: Funding: FY 1998 funds reprogrammed (-1233) to higher priority requirements.  
FY 1999 funds reprogrammed (-1981) to higher priority requirements.

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0602709A Night Vision Technology</b> | <b>PROJECT</b><br><b>DH95</b> |
|---|---|-------------------------------|

| COST <i>(In Thousands)</i>                     | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|--|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| DH95 Night Vision and Electro-Optic Technology | 16442             | 16636               | 17304               | 19213               | 19183               | 19872               | 20287               | 20744               | Continuing          | Continuing |

**A. Mission Description Item Justification:** This project develops core night vision and electronic sensor technologies for Army weapons systems. Advanced focal plane arrays, both infrared and multispectral, are being developed that will see farther, provide advanced signal processing, and improve performance on the dirty battlefield. Lightweight, high resolution common module optics and sensor technologies for future head-mounted vision systems are being developed for future aviators, infantry, armored vehicle crewmen, and field maintenance personnel. Multiwavelength, multifunction laser sources will provide affordable, high performance technology options for Army tactical laser rangefinding, designating, obstacle avoidance, biological agent detection, laser radar, and missile countermeasures. Automatic target recognition technologies will enable dramatic reductions in the time to acquire targets, detect land mines, and collect intelligence data while also reducing the warfighter's cognitive workload. Hardware-in-the-loop multispectral sensor simulations are being developed that will allow end-to-end predictive modeling, hardware design, and evaluation of new technologies in a virtual environment, while allowing warfighters to test these capabilities, develop tactics and techniques, and train in parallel with the hardware development process. This program element supports Force XXI Soldier, upgrades for Force XXI weapons systems, Army After Next future systems, as well as the Rapid Counter Multiple Rocket Launcher, Rapid Force Projection Initiative (RFPI), and Rapid Battlefield Visualization Advanced Concept Technology Demonstrations (ACTDs). 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. Work in this program element is related to and fully coordinated with PE 0602712A (Countermeasure Technology), PE0602270A (Electronic Warfare Technology), and PE 0603710A (Night Vision Advanced Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA. This program is dedicated to conducting applied research and tests of general technologies to meet specific military needs and is correctly placed in Budget Activity 2.

**FY 1996 Accomplishments:**

- 6420 – Completed thermal scene rendering capability for virtual imagery, provided data base for simulated night scene to the Dismounted Battlespace Battle Lab and validated representation of low observable target models in electronic terrain board system.  
– Conducted comparative evaluation of candidate automatic target recognition (ATR) algorithms for Hunter Sensor Suite, established beta site for rapid application specific sensor processing (RASSP) and conducted architecture analysis, using high density multi chip modules for Reconnaissance, Surveillance, and Target Acquisition Aided Target Recognition (RSTA ATR) applications.
- 6904 – Demonstrated fabrication of 128x128 staring detector array with on chip analog to digital conversion using molecular beam epitaxial (MOMBE) microfactory, continued evaluation of staring focal plane arrays (FPAs) for imaging applications and established performance metrics and preliminary performance models.
- 3118 – Completed design trade-offs for objective and ocular optics for common helmet mounted vision system (HMVS) and demonstrated binary optics hybrid for potential cost/weight reductions.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602709A Night Vision Technology</b> | <b>PROJECT</b><br><b>DH95</b> |
| <p><b>FY 1996 Accomplishments:</b><br/>(continued)</p> <ul style="list-style-type: none"> <li>- Conducted laboratory demonstrations of optical parametric oscillator (OPO) techniques to generate multiple wavelengths in the 1-5 micron region for multiple laser applications, and initiated development of multifunctional control software.</li> </ul> <p>Total        16442</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            5386 - Evaluate staring focal plane performance against preliminary model; refine modeling capability and staring focal plane array metrics and assess producibility; demonstrate readout integrated circuits for non-uniformity correction, image enhancement and dynamic range control for advanced focal plane arrays.</li> <li>•            4367 - Develop core display electronics and sensor technologies for multiple HMVS applications and fabricate advanced optic components for demonstration. <ul style="list-style-type: none"> <li>- Demonstrate multifunction laser control software for rangefinding, designating, and profiling and burst-mode eyesafe laser technology. Initiate producibility/affordability program.</li> </ul> </li> <li>•            6772 - Extend ATR evaluation capability to millimeter wave (MMW) radar applications; assess improvements in search effectiveness and target acquisition when gunner or image analyst is aided with ATR; demonstrate tank cuer using commercial off the shelf (COTS) software / high density multi chip module. <ul style="list-style-type: none"> <li>- Demonstrate virtual scene simulation, integrated with realistic terrain and cultural features, shadowing, diurnal cycle effects, and near infrared image intensifier simulation.</li> <li>- Initiate development of synthetic mine signatures and support development of evaluation methodology for aided mine detection algorithms.</li> </ul> </li> <li>•            111 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total        16636</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            4993 - Evaluate the practicality and affordability of large single spectrum staring/scanning arrays along with validated imager performance models for transition to high sensitivity integrated detector/dewar demonstration; and demonstrate smart on-chip functions such as spatial and temporal filtering.</li> <li>•            1420 - Develop compact fundamental laser module and wavelength conversion modules that can be combined as needed for different applications such as target designation, eyesafe rangefinding, laser radar, and chemical detection.</li> <li>•            7591 - Integrate advanced FLIR/ MMW radar ATR evaluation capability for multi-sensor RSTA applications; incorporate low power, miniaturized high performance components into ATR hardware for compact applications. <ul style="list-style-type: none"> <li>- Initiate development of real-time multi-spectral (0.4 to 14 microns) scene-rendering capability for insertion into prototyping and wargame simulations.</li> </ul> </li> </ul> |   |                               |
| Project DH95   | <i>Page 2 of 3 Pages</i>  | Exhibit R-2 (PE 0602709A)     |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
|--|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|-------------------------|-------|-------|-------|-------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602709A Night Vision Technology</b> | PROJECT<br><b>DH95</b>       |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| <p align="center">– Support development of synthetic mine signatures and evaluation of aided mine detection algorithms.</p> <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 3300 – Initiate development of a low cost solid state near IR focal plane with spectral sensitivities from 0.2 micron to 1.8 micron as a high resolution, lightweight replacement to image intensifier tubes.</li> </ul> <p>Total 17304</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5487 – Demonstrate multispectral sensing and partition smart functions between on- and off-focal plane processing, and demonstrate analog to digital and multi-band fusion processing on the focal plane.</li> <li>• 1570 – Demonstrate multiwavelength laser modules for common source for multi-function and multi-application lasers.</li> <li>• 7856 – Conduct ATR evaluations of multispectral and large format staring IR sensors in increasingly complex dynamic operational scenarios, and integrate off focal plane ATR processing with smart focal plane array.                         <ul style="list-style-type: none"> <li>– Demonstrate a real-time multi-spectral scene rendering (0.4 to 14 microns) capability in a wargame simulation.</li> <li>– Provide mine signature simulation and aided mine detection evaluation support to land mine center of excellence.</li> </ul> </li> <li>• 4300 – Demonstrate a low cost solid state near IR camera with superior sensitivity to present I<sup>2</sup> tubes for multispectral applications from UV, visible, to near IR.</li> </ul> <p>Total 19213</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: right;">16624</td> <td style="text-align: right;">16994</td> <td style="text-align: right;">17842</td> <td style="text-align: right;">19143</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: right;">17086</td> <td style="text-align: right;">16636</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: right;">-664</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: right;">16442</td> <td style="text-align: right;">16636</td> <td style="text-align: right;">17304</td> <td style="text-align: right;">19213</td> </tr> </tbody> </table> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 16624 | 16994 | 17842 | 19143 | Appropriated Value | 17086 | 16636 |  |  | Adjustments to Appropriated Value | -664 |  |  |  | FY1998 Pres Bud Request | 16442 | 16636 | 17304 | 19213 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| FY 1997 President's Budget   | 16624  | 16994                        | 17842          | 19143          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| Appropriated Value   | 17086  | 16636                        |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| Adjustments to Appropriated Value  | -664   |                              |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| FY1998 Pres Bud Request  | 16442  | 16636                        | 17304          | 19213          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| Project DH95   | <i>Page 3 of 3 Pages</i>                                       | Exhibit R-2 (PE 0602709A)    |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0602712A Countermine Applied Research</b> |
|---|--|

| COST <i>(In Thousands)</i>      | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|---------------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| Total Program Element (PE) Cost | 0                 | 7372                | 10598               | 10715               | 10485               | 10574               | 10781               | 11020               | Continuing          | Continuing |
| AH24 Countermine Technology     | 0                 | 6041                | 9448                | 8301                | 8324                | 8088                | 8243                | 8422                | Continuing          | Continuing |
| AH35 Camouflage Technology      | 0                 | 0                   | 799                 | 2058                | 2161                | 2486                | 2538                | 2598                | Continuing          | Continuing |
| AC61 TRACTOR QUAKE              | 0                 | 1331                | 351                 | 356                 | 0                   | 0                   | 0                   | 0                   | 0                   | 2038       |

**Mission Description and Budget Item Justification:** This program element provides countermine and advanced signature management technologies. The specific countermine efforts include remote detection of minefields, and detection and neutralization of individual mines from moving vehicles and manportable systems. Advanced robotics technologies will be emphasized to minimize threats to weapons systems and personnel. Breaching and neutralization techniques will be developed for both conventional and electronically activated mines that can act at a distance. A Center of Excellence for land mine detection will coordinate and standardize development of mine signature simulations, provide a catalogue of mine signatures, and support evaluation of aided mine detection algorithms. Advanced signature management techniques will provide mobile and semi-mobile assets (e.g., Abrams, Theater Missile Defense) with low cost, low burden survivability enhancements addressing detection avoidance and hit avoidance in global battlefield conditions. The Army has focused its resources and is expediting these programs in coordination with the US Marine Corps. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on conventional air/surface weapons and ground vehicles. Work in this program element is related to and fully coordinated with PE0602709A (Night Vision and Electro-Optics Technology), PE 0603606A (Countermine and Barrier Development), and PE0603710A (Night Vision Advanced Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA. This program is dedicated to conducting applied research and tests of general technologies to meet specific military needs and is therefore correctly placed in Budget Activity 2.



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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0602712A Countermine Applied Research</b> | <b>PROJECT</b><br><b>AH24</b> |
|---|--|-------------------------------|

| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|-----------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| AH24 Countermine Technology | 0                 | 6041                | 9448                | 8301                | 8324                | 8088                | 8243                | 8422                | Continuing          | Continuing |

**A. Mission Description and Justification:** Countermine research will focus on remote detection of minefields, and detection and neutralization of individual mines from moving vehicles and manportable systems. Advanced robotics technologies will be developed to minimize threats to weapons systems and personnel. Breaching and neutralization techniques will be developed for both conventional and electronically activated mines that can act at a distance. A Center of Excellence for land mine detection will coordinate and standardize development of mine signature simulations, provide a catalogue of mine signatures, and support evaluation of aided mine detection algorithms. Advanced signature management techniques will provide mobile and semi-mobile assets (e.g., Abrams, Theater Missile Defense) with low cost, low burden survivability enhancements addressing detection avoidance and hit avoidance in global battlefield conditions. Efforts for camouflage technologies are restructured to Project AH35 of this PE beginning in FY 1998.

**FY 1996 Accomplishments:** Funded in PE 0602786A (Logistics Technology), AH20.

**FY 1997 Planned Program:**

- 660 – 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.
  - 4010 – Evaluate imaging infrared (IR) and frequency agile radar for application to the Mine Hunter Killer; fabricate and integrate directed energy brassboard system.
  - 1224 – Evaluate underpinning enhancements to forward looking radar and determine technical performance parameters required to achieve probability of detection of 98% with a false alarm rate of <0.2 per meter of forward progress.
  - 147 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 6041

**FY 1998 Planned Program:**

- 7961 – Investigate a variety of new component and focal plane array (FPA) technologies, such as 3-5 micron staring FPAs, multi/hyperspectral, passive polarization active sources and electronic stabilization to support a lightweight, airborne stand-off mine detection capability for limited area (point) detection.
  - Evaluate advanced IR, passive millimeter wave, and ultra-wide band radar technologies to significantly extend standoff detection ranges against antitank mines.
  - Complete design of an explosive neutralizer as part of the Mine Hunter/Killer.

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0602712A Countermine Applied Research</b> | <b>PROJECT</b><br><b>AH24</b> |
|---|--|-------------------------------|

**FY 1998 Planned Program: (continued)**

- 1487 – Initiate development of mine signature simulations, initiate database of mine signatures, and establish methodology for evaluation of aided detection algorithms in support of land mine detection Center of Excellence.
- Total 9448

**FY 1999 Planned Program:**

- 7817 – Complete study efforts and initiate critical component development for the lightweight, airborne stand-off mine detection technology demonstration for limited area (point) detection and the detection of mines on major supply routes.
    - Investigate acoustic and seismic technologies as an additional means of enhancing the ability to remotely detect mines at speeds of 5-20 km/hr.
    - Complete enhancements to advanced mine detection sensors, integrate sensors, and conduct static testing as part of the Mine Hunter/Killer .
  - 484 – Continue development of mine signature simulations, cataloguing of mine signatures, and assessments of aided mine detection algorithms in support of land mine detection center of excellence.
- Total 8301

**B. Project Change Summary**

|   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|---|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget Appropriated Value | 0              | 4670           | 6263           | 7384           |
| Adjustments to Appropriated Value             |                | 6041           |                |                |
| FY1998 Pres Bud Request                       | 0              | 6041           | 9448           | 8301           |

Change Summary Explanation: Funding- FY1997 (+1371) Congressional increase.  
 FY 1998 (+3185)/ FY 1999 (+917)- Funding increased to address high priority requirements for mine detection and neutralization.

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|---|---|---|---|---|-----------------------------------|--|--|--|--|--------------------------|---|---|-----|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602712A Countermine Applied Research</b> |                     |                           |                     | PROJECT<br><b>AH35</b>       |                     |            |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |
| AH35 Camouflage Technology  | 0                 | 0                   | 799                 | 2058  | 2161                | 2486                      | 2538                | 2598                         | Continuing          | Continuing |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |
| <p><b>A. <u>Mission Description and Justification:</u></b> Develop signature management and deception technologies that deny acquisition of friendly force assets from threat sensors. Demonstrations will be supported by signature characterization, modeling and simulation conducted under the Integrated Sensor Modeling and Simulation effort. These signature management and deception systems provide mobile and semi-mobile assets with low cost, low operational burden survivability upgrades addressing detection avoidance in global battlefield conditions. This project is a restructure from project AH24.</p> <p><b>FY 1996 Accomplishments:</b> Funded in PE 0602786A (Logistics Technology), AH20.</p> <p><b>FY 1997 Planned Program:</b> Funded in project AH24 of this PE.</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 799 – Complete feasibility studies for advanced camouflage and deception technologies.</li> <li>– Develop and demonstrate passive IR coatings for signature suppression of vehicles.</li> </ul> <p>Total 799</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2058 – Develop reactive IR suppressive coatings.</li> <li>– Develop appliqué/structures to reduce vehicle and solar loading signatures over an extended period of a diurnal cycle and in varying backgrounds.</li> <li>– Develop electronically projected, multispectral decoy to replicate the signature of a combat vehicle.</li> </ul> <p>Total 2058</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget Appropriated Value</td> <td align="center">0</td> <td align="center">0</td> <td align="center">0</td> <td align="center">0</td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="center">0</td> <td align="center">0</td> <td align="center">799</td> <td align="center">2058</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: This project is a restructure of funds beginning in FY 1998 to highlight camouflage research activities.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget Appropriated Value | 0 | 0 | 0 | 0 | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 0 | 799 | 2058 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                           |                     |                              |                     |            |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |
| FY 1997 President's Budget Appropriated Value   | 0                 | 0                   | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |
| Adjustments to Appropriated Value   |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |
| FY 1998 Pres Bud Request  | 0                 | 0                   | 799                 | 2058  |                     |                           |                     |                              |                     |            |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |
| Project AH35  |                   | Page 4 of 4 Pages   |                     |   |                     | Exhibit R-2 (PE 0602712A) |                     |                              |                     |            |  |                |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                          |   |   |     |      |

DATE  
**February 1997**

BUDGET ACTIVITY  
**2 - Applied Research**

PE NUMBER AND TITLE  
**0602712A Countermine Applied Research**

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                           |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602716A Human Factors Engineering Technology</b> |                           |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate       | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 15445             | 15968               | 14256               | 15626  | 14149                     | 14275               | 14687               | 15171                        | Continuing          | Continuing |
| AH34 Rural Health Technology   | 3319              | 2203                | 0                   | 0  | 0                         | 0                   | 0                   | 0                            | 0                   | 5522       |
| AH70 Human Factors Engineering Systems Development   | 12126             | 13765               | 14256               | 15626  | 14149                     | 14275               | 14687               | 15171                        | Continuing          | Continuing |
| <p><b>Mission Description and Budget Item Justification:</b> The objectives of this program are, first, to maximize the effectiveness of soldiers in concert with their materiel so that they may survive and prevail on the battlefield. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of soldiers, with particular attention on soldier and equipment interaction. Secondly, this project focuses on improving health care in remote areas through research and technology development in distance learning and professional collaboration (teleconsulting and telepracticing). The work in this latter effort complements related Army programs in soldier performance, training and evaluation methodologies, and will provide direct research benefits to the Army's medical community, including combat casualty care on the battlefield and in other remote areas of operation. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. All work under this PE is part of the Human Systems Tri-Service Reliance panel. These projects include non-system specific development efforts pointed toward specific military needs and therefore are appropriate to Budget Activity 2.</p> |                   |                     |                     |  |                           |                     |                     |                              |                     |            |
| <i>Page 1 of 7 Pages</i>   |                   |                     |                     |  | Exhibit R-2 (PE 0602716A) |                     |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                          | <b>PE NUMBER AND TITLE</b><br><b>0602716A Human Factors Engineering Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>AH34</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| AH34 Rural Health Technology   | 3319              | 2203                | 0                        | 0  | 0                   | 0                   | 0                         | 0                             | 0                   | 5522       |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project focuses on improving health care in remote areas through research and technology development in distance learning. The objectives are: (1) identify the best practices in remote training and education, and (2) demonstrate the value of selected strategies, technologies and methodologies. This project is performed by Saint Francis College in Loretto, Pennsylvania and its Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA), with technical oversight and coordination by the Naval School of Health Sciences. Funds were forwarded to the Navy for program execution.</p> <p>The FY97 Congressionally-mandated program provides for the continued development, field testing, and empirical validation of methods for improving the coordinated functioning of emergency medical teams (both military and civilian). This multi-year project, initiated at the direction of the Army Chief of Staff in FY94 and supported by Congress in FY96, extends previous Army research on the effective training and evaluation of military aviation crews and systematically applies it to the collection of hospital and pre-hospital personnel who must perform as an effective team during the initial "golden hour" of shock/trauma or acute patient care. Additionally, this project provides both the civilian and military medical communities with a rigorous framework for objectively demonstrating and assessing the "value-added" of selected telemedicine and medical decision management technologies.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3319 - Developed and demonstrated distance learning technologies for: (1) increasing specific health care provider skills and education, and (2) linking providers to innovative distance learning modalities, such as short term continuing education units, community-based wellness education, school-based health programs, and Masters of Medical Science remote education and Internet sources.</li> </ul> <p>Total 3319</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2149 -Complete development of prototype team training and evaluation packages for emergency medicine (Madigan Army Medical Center and Rhode Island Hospital).<br/>-Identify military and civilian hospital sites for field validation of training and evaluation packages (eight hospitals to be determined).<br/>-Conduct comparative investigations of teleconsulting versus on-site decision aids for field intubation of trauma patients (Univ of Maryland Shock Trauma Center).<br/>-Initial examination of patient simulator technology for "value added" to emergency medical team performance.</li> <li>• 54 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2203</p> |                   |                     |                          |  |                     |                     |                           |                               |                     |            |
| Project AH34   |                   |                     | <i>Page 2 of 7 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0602716A) |                               |                     |            |

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|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|---|---|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602716A Human Factors Engineering<br/>Technology</b> | <b>PROJECT</b><br><b>AH34</b> |                |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p>   |  |                               |                |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">3405</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3500</td> <td style="text-align: center;">2203</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-181</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">3319</td> <td style="text-align: center;">2203</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 funding provided by Congress (+2203) to evaluate human factors in emergency medical teams.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 3405 | 0 | 0 | 0 | Appropriated Value | 3500 | 2203 |  |  | Adjustments to Appropriated Value | -181 |  |  |  | FY 1998 Pres Bud Request | 3319 | 2203 | 0 | 0 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1997 President's Budget  | 3405   | 0                             | 0              | 0              |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Appropriated Value  | 3500   | 2203                          |                |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Adjustments to Appropriated Value   | -181   |                               |                |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1998 Pres Bud Request  | 3319   | 2203                          | 0              | 0              |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Project AH34  | <i>Page 3 of 7 Pages</i>   | Exhibit R-2 (PE 0602716A)     |                |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602716A Human Factors Engineering<br/>Technology</b> |                     |                     |                           |                              | PROJECT<br><b>AH70</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| AH70 Human Factors Engineering Systems<br>Development   | 12126             | 13765               | 14256               | 15626   | 14149               | 14275               | 14687                     | 15171                        | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This program focuses on maximizing the effectiveness of the soldier in concert with his materiel, 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3579 - Developed 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. <ul style="list-style-type: none"> <li>- Collected performance data on sensor-human feedback interface devices, exoskeleton control devices for human positioning and monitoring and multi degree of freedom force sensors. Completed advanced armored vehicle technology (AAVT) study on armor vehicle containerization. Continued the palletized loading system container lift kit study.</li> <li>- Improved the auditory detection model (ADM) through localization and impulse noise detection.</li> <li>- Conducted performance research to evaluate advanced controls and displays for a force "on the move" in adverse environments.</li> </ul> </li> <li>• 6850 - Completed input of latest anthropometric data and added the capability for surface mapping, simulated uniforms and basic equipment restrictions to the human figure performance model (JACK). <ul style="list-style-type: none"> <li>- Developed Improved Performance Research Integration Tool (IMPRINT), version 1.0, accreditation review report. Developed IMPRINT version 2.0, with full-scale analysis and process-linked capability. Developed trade-off tool to assess effects of available manpower and personnel characteristics on system redesign options, and validated tool with human factors engineering field data.</li> <li>- Continued efforts to develop a simulation capability for the individual soldier fighting system in a distributed interactive simulation (DIS) environment through the use of virtual reality and synthetic environment technologies.</li> <li>- Continued enhanced human factors engineering field evaluation methods with soldier-in-the-loop operational test exercise data to upgrade capabilities to assess new technologies and systems.</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                        |            |
| Project AH70  |                   |                     | Page 4 of 7 Pages   |   |                     |                     | Exhibit R-2 (PE 0602716A) |                              |                        |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602716A Human Factors Engineering Technology</b> | PROJECT<br><b>AH70</b>       |
| <p><b>FY 1996 Accomplishments: (continued)</b></p> <ul style="list-style-type: none"> <li>• 1697 - Provided human factors engineering (HFE) support to AMC, AMC RDEC installations, Training and Doctrine Command (TRADOC), battle labs and laboratories.</li> <li>- Initiated development of soldier-information system performance metrics for the digitized battlefield.</li> </ul> <p>Total 12126</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4598 - Within the knowledge-based logistics planning shell (KBLPS) tool framework, demonstrate mechanisms for constructing, automatically updating and interactively presenting multi-media staff briefings, incorporating large quantities of complex information for command and control and logistics.</li> <li>- Develop forklift enhancement data on International Standard Organization (ISO) container unstuffing to validate operator interface improvements.</li> <li>- 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.</li> <li>- Continue efforts to collect performance data on sensor human feedback interface devices and exoskeleton control devices. Research focus will be on lightening the soldier's load, focusing primarily on fatigue reduction.</li> <li>- Incorporate auditory performance parameters into metrics to enhance soldier survivability.</li> <li>- Conduct simulations in a distributed interactive simulation (DIS) environment for decision making by a dispersed force.</li> <li>• 3332 - Demonstrate and distribute human figure performance model (JACK) Army wide.</li> <li>- Complete Improved Performance Research Integration Tool (IMPRINT), version 2.0 accreditation review report and continue efforts to develop trade-off tools to evaluate soldier and unit performance and life cycle cost implications of choices in concept and system designs.</li> <li>- Continue efforts to develop and deliver a virtual reality (VR) capability for the individual soldier fighting system in a DIS environment through the use of VR and synthetic environment technologies, e.g., high resolution visual displays, computer image generators, 3-D audio, etc.</li> <li>• 5791 - Evaluate and validate soldier-system analysis tools in an operational environment and evaluate new system concepts, e.g., battle command vehicle.</li> <li>- Provide HFE support to AMC, AMC RDEC installations, Training and Doctrine Command (TRADOC), battle labs and laboratories.</li> <li>- Develop a draft Army standard set of soldier-information system performance metrics and demonstrate in the context of Task Force 97.</li> <li>44 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 13765</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4791 -Refine and enhance interactive logistics planning tools for integration into Logistics Anchor Desk.</li> </ul> |   |                              |
| Project AH70  | Page 5 of 7 Pages   | Exhibit R-2 (PE 0602716A)    |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |   | DATE<br>February 1997     |
|---|---|---------------------------|
| BUDGET ACTIVITY<br>2 - Applied Research   | PE NUMBER AND TITLE<br>0602716A Human Factors Engineering<br>Technology | PROJECT<br>AH70           |
| <p>-Continue to investigate control and operator sensing strategies and configurations for teleoperated manipulator devices performing military tasks. Initiate development of operator workload models for unmanned ground vehicles.</p> <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>-Publish findings on sensor human feedback devices and exoskeleton control devices.</li> <li>-Continue to verify and validate the auditory detection model. Conduct a study to assess the impact of multi-directional auditory displays on crew performance in armored vehicles.</li> <li>-Continue to conduct simulations in a distributed interactive simulation (DIS) environment for decision making by a dispersed force.</li> <li>• 3991 -Continue to develop unique features and refinements to the human figure performance model (JACK) with emphasis on improving run-time, user interface and fidelity and decreasing the time and cost to use critical features.</li> <li>-Complete Improved Performance Research Integration Tool (IMPRINT), version 3, which incorporates embedded analysis wizard, advanced workload analysis capability, and updated resident databases.</li> <li>-Refine the virtual reality capability for the individual soldier fighting systems in a DIS environment; integrate the sensor suit (which records the movements of humans engaged in strenuous exercise) and a low to medium resolution version of the soldier icon (JACK); initiate collection of baseline data for live and virtual studies.</li> <li>• 5474 -Continue to develop soldier-system analysis and tradeoff tools for assessing soldier and unit performance and the life cycle cost implications of choices in concept and system designs.</li> <li>-Provide HFE support to AMC, AMC RDECs, TRADOC activities, battle labs, and other laboratories.</li> <li>-Develop an integrated set of soldier-information system performance based design standards and demonstrate in Division 98.</li> </ul> <p>Total 14256</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5761 -Demonstrate integrated logistic planning tools in advanced warfighting experiments and related Force XXI activities.</li> <li>-Continue development of operator workload models for unmanned ground vehicles; conduct user operational investigations in countermining operations, and reconnaissance, surveillance and target acquisition operations; incorporate results into the operator workload model.</li> <li>-Expand the study investigating the impact of multi-directional auditory displays to helicopter pilot performance and dismounted soldier performance.</li> <li>-Develop a human performance measurement strategy to assess new command and control concepts in the distributed interactive simulation (DIS) environment.</li> <li>-Develop performance-based specifications for prioritizing the Army's investment in advanced 2-D and 3-D visualization concepts across the battle staff's task domain, and in new media technologies that support collaborative planning and problem solving by a geographically dispersed staff. Initiate development of a cognitive task analysis model to examine the impact of new media technologies on battlefield command and control.</li> </ul> |   |                           |
| Project AH70  | Page 6 of 7 Pages   | Exhibit R-2 (PE 0602716A) |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602716A Human Factors Engineering<br/>Technology</b> | <b>PROJECT</b><br><b>AH70</b> |
| <ul style="list-style-type: none"> <li>• 4667 -Verify and validate the human figure performance model (JACK), link with physics based model, and begin to incorporate data collected in 3-D.<br/>-Add training requirements analysis capability and enhanced performance degradation modeling to Improved Performance Research Integration Tool (IMPRINT) Version 3.</li> </ul> <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Collect performance data using the virtual reality capability for the individual soldier fighting systems in a DIS environment, compare results of live and virtual studies, and update and validate the databases with actual research data.</li> </ul> <ul style="list-style-type: none"> <li>• 5198 -Initiate development of an integrated soldier-system analysis and design tool supporting materiel design, doctrine writing and training architecture development. Continue enhanced human factors engineering field evaluation methods with soldier in the loop operational test data to upgrade existing capabilities to assess new technologies and systems.<br/>-Provide HFE support to AMC, AMC RDECs, TRADOC activities, battle labs, and other laboratories.</li> </ul> <p>Total        15626</p> |  |                               |
| <b>B. <u>Project Change Summary</u></b>   |  |                               |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                |
| FY 1997 President's Budget  | 12195  | 14072                         |
| Appropriated Value  | 12534  | 13765                         |
| Adjustments to Appropriated Value   | -408   |                               |
| FY 1998 Pres Bud Request  | 12126  | 13765                         |
|   |  | 14256                         |
|   |  | 15626                         |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |                |                  |                  |  |                  |                  |                  |                  | DATE<br>February 1997 |            |
|--|----------------|------------------|------------------|--|------------------|------------------|------------------|------------------|-----------------------|------------|
| BUDGET ACTIVITY<br>2 - Applied Research  |                |                  |                  | PE NUMBER AND TITLE<br>0602720A Environmental Quality Technology |                  |                  |                  |                  |                       |            |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete      | Total Cost |
| Total Program Element (PE) Cost  | 25537          | 55178            | 17519            | 13869  | 13782            | 14747            | 15062            | 15617            | Continuing            | Continuing |
| D048 Industrial Operations Pollution Control Technology  | 1407           | 5945             | 2439             | 2501   | 2593             | 2722             | 2803             | 2889             | Continuing            | Continuing |
| A822 Facility Environmental Management and Monitoring System (FEMMS)   | 0              | 1958             | 0                | 0  | 0                | 0                | 0                | 0                | 0                     | 1958       |
| A823 Hawaii Small Business Development Center  | 5121           | 5287             | 0                | 0  | 0                | 0                | 0                | 0                | 0                     | 10408      |
| A826 Unexploded Ordnance Remediation   | 0              | 3916             | 0                | 0  | 0                | 0                | 0                | 0                | 0                     | 3916       |
| A829 National Defense Center for Environmental Excellence (NDCEE) Technology   | 12516          | 12895            | 5269             | 0  | 0                | 0                | 0                | 0                | 0                     | 30680      |
| A835 Military Medical Environmental Criteria   | 2340           | 3103             | 3418             | 3308   | 3276             | 3744             | 3823             | 4014             | Continuing            | Continuing |
| A876 Plasma Energy Pyrolysis System  | 0              | 7343             | 0                | 0  | 0                | 0                | 0                | 0                | 0                     | 7343       |
| A877 Western Environmental Technology Office Environmental Support   | 0              | 4895             | 0                | 0  | 0                | 0                | 0                | 0                | 0                     | 4895       |
| A896 Base Facility Environmental Quality   | 2436           | 7257             | 3067             | 4553   | 4336             | 4566             | 4610             | 4762             | Continuing            | Continuing |
| AF25 Military Environmental Restoration Technology   | 1717           | 2579             | 3326             | 3507   | 3577             | 3715             | 3826             | 3952             | Continuing            | Continuing |
| <p><b>Mission Description and Budget Item Justification:</b> This Program Element (PE) provides technology that allows the Army to comply with regulations mandated by all Federal, State and local environmental/health laws and to reduce the cost of this compliance. Examples of key laws include the Superfund Amendments and Reauthorization Act of 1986 and the Defense Environmental Restoration Act (the DoD equivalent of this law), in addition to the Resource Conservation and Recovery Act of 1984, as amended. This PE provides the Army with a capability to decontaminate or neutralize Army-unique hazardous and toxic wastes at sites containing waste ammunition, explosives, heavy metals, propellants, smokes, chemical munitions, and other organic contaminants. The current DoD estimate for the total Army cost of completing this</p> |                |                  |                  |  |                  |                  |                  |                  |                       |            |

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|--|--|---------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE                              |                           |
| <b>2 - Applied Research</b>  | <b>0602720A Environmental Quality Technology</b> |                           |
| <p>cleanup program is eight to ten billion dollars. This PE also provides technology to avoid the potential for future hazardous waste problems, by reducing hazardous waste generation through process modification and control, materials recycling and substitution. This PE develops pollution control technology which assists installations to comply with environmental regulations at less cost. The PE also provides technology to mitigate noise impacts and maneuver area damage resulting from Army training activities. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Defense Reliance Agreements on civil engineering and environmental quality with oversight provided by the Joint Engineers and Armed Services Biomedical Research Evaluation and Management. These projects include non-system specific development efforts directed at specific military needs and are appropriate to Budget Activity 2.</p> |  |                           |
| <i>Page 2 of 19 Pages</i>  |  | Exhibit R-2 (PE 0602720A) |

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|---|-------------------|---------------------|---------------------------|--|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                           |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                           | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D048</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate       | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D048 Industrial Operations Pollution Control Technology   | 1407              | 5945                | 2439                      | 2501   | 2593                | 2722                | 2803                      | 2889                          | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides pollution control technologies required to reduce the cost of treating hazardous toxic effluent from the operation of Army industrial installations, which include ammunition plants, depots and arsenals, and to satisfy increasingly stringent wastewater discharge standards under the Clean Water Act and relevant state regulations. Federal facilities are now subject to fines and facility shutdowns for violation of federal, state, and local air and wastewater discharge regulations. This new technology is essential to control and reduce generation of hazardous waste, to satisfy hazardous waste reduction goals and to avoid future hazardous waste disposal costs and liabilities to the Army. This project will provide compliance tools to control toxic air pollutants regulated under the Clean Air Act amendments. Efforts will focus on new energetic materials which will enter the Army inventory within the next decade to assure that ammunition plants will remain compliant. Changes in solid, liquid, and gaseous emissions resulting from pollution prevention efforts will require technology changes to existing treatment systems to compensate. The primary developing agency is the US Army Construction Engineering Research Laboratories, Champaign, IL.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 807 - Developed transition plans for nitrocellulose treatment technology. <ul style="list-style-type: none"> <li>- Developed guidance on reduced smoke propellants as a fuel source.</li> <li>- Developed guidance on air toxins from plating operations.</li> </ul> </li> <li>• 600 - Initiated development of technology for reuse of waste ammonium nitrate. <ul style="list-style-type: none"> <li>- Developed volatile organic compound (VOC) treatment technology for industrial operations.</li> </ul> </li> </ul> <p>Total 1407</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1972 - Develop preliminary guidance on pyrolytic behavior of energetic materials. <ul style="list-style-type: none"> <li>- Develop guidelines for treatment and use of munitions wastes.</li> <li>- Develop biofilter technology for treatment of VOCs from industrial operations.</li> </ul> </li> <li>• 3873 - Congressionally directed effort to demonstrate a wastewater treatment testbed at the Bremerton Naval Shipyard (to be executed by Navy).</li> <li>• 100 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5945</p> |                   |                     |                           |  |                     |                     |                           |                               |                     |            |
| Project D048  |                   |                     | <i>Page 3 of 19 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0602720A) |                               |                     |            |

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|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> | <b>PROJECT</b><br><b>D048</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2439 - Initiate development of adaptive tuning control algorithms for industrial wastewater treatment plant automation.</li> <li style="padding-left: 20px;">- Develop biofilter technology for treatment of VOCs from industrial operations.</li> <li style="padding-left: 20px;">- Develop improved biological treatment technologies for energetic wastewater employing sulfate reduction environments.</li> <li style="padding-left: 20px;">- Develop engineered gelatin technology for stabilization of industrial waste streams contaminated with heavy metals.</li> </ul> <p>Total 2439</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2501 - Develop technology for electrochemical reduction of energetic compounds in water.</li> <li style="padding-left: 20px;">- Develop technology and guidelines for minimizing hazardous air pollutant emissions from industrial operations supporting Army installations.</li> <li style="padding-left: 20px;">- Initiate development of technology and guidelines for using focused high energy acoustic beams to destroy energetic contaminated industrial wastes.</li> <li style="padding-left: 20px;">- Develop thermal plasma techniques for the pyrolytic destruction of organic energetic wastes and the vitrification of heavy metal-bearing wastes.</li> </ul> <p>Total 2501</p> |  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b><u>B. Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1498</td> <td style="text-align: center;">2072</td> <td style="text-align: center;">2426</td> <td style="text-align: center;">2485</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1539</td> <td style="text-align: center;">5945</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-130</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1407</td> <td style="text-align: center;">5945</td> <td style="text-align: center;">2439</td> <td style="text-align: center;">2501</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY1997 - Congressionally-directed effort to demonstrate a wastewater treatment testbed at the Bremerton Naval Shipyard (+3873).</p>   |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1498 | 2072 | 2426 | 2485 | Appropriated Value | 1539 | 5945 |  |  | Adjustments to Appropriated Value | -130 |  |  |  | FY 1998 Pres Bud Request | 1407 | 5945 | 2439 | 2501 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 1498   | 2072                          | 2426           | 2485           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 1539   | 5945                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -130   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 1407   | 5945                          | 2439           | 2501           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project D048  | Page 4 of 19 Pages   | Exhibit R-2 (PE 0602720A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|--|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> |                     |                           |                     | <b>PROJECT</b><br><b>A822</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| A822 Facility Environmental Management and Monitoring System (FEMMS)  | 0                 | 1958                | 0                   | 0  | 0                   | 0                         | 0                   | 0                             | 0                   | 1958       |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> - This Congressionally-mandated pollution prevention project is managed by the Army to further develop and implement a testbed demonstrator at Tobyhanna Army Depot (TYAD) for automated control and real-time monitoring management of environmental emissions, pollutants, and wastes. Phase I was completed in FY 95 with the identification and analysis of TYAD facility environmental management needs, the conceptualization of the FEMMS, prototype module designs, and implementation of FEMMS in coordination with the National Defense Center for Environmental Excellence (NDCEE). Phase II was completed in 1st quarter FY 96 with the selection of baseline FEMMS module designs.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1910 - Expand consideration of pollutants and wastes at TYAD being monitored by FEMMS.<br/>- Develop additional FEMMS modules; complete project.</li> <li>• 48 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1958</p> <p><b>FY 1998 Planned Program:</b> Effort completed with FY 1997 funding.</p> <p><b>FY 1999 Planned Program:</b> Effort completed with FY 1997 funding.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1996</u></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td></td> <td style="text-align: center;">1958</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1958</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997 - Congressional plus-up (+1958) for additional development of FEMMS.</p> |                   |                     |                     |  |                     |                           |                     |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value |  | 1958 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 1958 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget  | 0                 | 0                   | 0                   | 0  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value  |                   | 1958                |                     |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value   |                   |                     |                     |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request  | 0                 | 1958                | 0                   | 0  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project A822  |                   |                     | Page 5 of 19 Pages  |  |                     | Exhibit R-2 (PE 0602720A) |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |



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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> |                     |                           |                     | PROJECT<br><b>A823</b>       |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| A823 Hawaii Small Business Development Center  | 5121              | 5287                | 0                   | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 10408      |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> This Congressionally-mandated project 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 approach being followed involves private-public partnerships to carry out activities leading to the commercialization of these products. These include but are not limited to pharmaceuticals, industrial products, and food products derived from the agricultural resources of transitioning sugar plantations in Hawaii. Advisory personnel from federal agencies (primarily the Departments of Defense and Agriculture) and state agencies participate at the work group and oversight committee levels.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5121 - Continued development of agricultural-industrial products having potential for dual-use and commercialization, focusing on native Hawaiian agricultural crops with potential application for medicine/food/biofuel use in the military.</li> </ul> <p>Total 5121</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5158 - Continue development of agricultural-industrial products having potential for dual-use and commercialization, focusing on native Hawaiian agricultural crops with potential application for medicine/food/bioremediation use in the military.</li> <li>• 129 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5287</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5253</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5400</td> <td style="text-align: center;">5287</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-279</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">5121</td> <td style="text-align: center;">5287</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY1997 - Congressional plus-up (+5287) for additional development of agricultural-industrial products.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5253 | 0 | 0 | 0 | Appropriated Value | 5400 | 5287 |  |  | Adjustments to Appropriated Value | -279 |  |  |  | FY 1998 Pres Bud Request | 5121 | 5287 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1997 President's Budget   | 5253              | 0                   | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Appropriated Value   | 5400              | 5287                |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Adjustments to Appropriated Value  | -279              |                     |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1998 Pres Bud Request   | 5121              | 5287                | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Project A823   |                   | Page 6 of 19 Pages  |                     |   |                     | Exhibit R-2 (PE 0602720A) |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b> | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> | PROJECT<br><b>A826</b> |
|--|---|------------------------|

| COST (In Thousands)                  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|--------------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| A826 Unexploded Ordnance Remediation | 0              | 3916             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 3916       |

**A. Mission Description and Justification:** This project is of Congressional special interest. The purpose of the project is to conduct a demonstration of technology to detect and remediate unexploded ordnance (UXO) using the Jefferson Proving Ground (JPG) as the test site. 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 will be conducted in detection, discrimination, identification, characterization, and monitoring of UXO. Emphasis will be placed on the development of near real-time sensing and insitu remediation.

**FY 1996 Accomplishments:** Project not funded in FY 96

**FY 1997 Planned Program:**

- 3821 - Develop geophysical methods for the identification and discrimination of UXO.
    - Develop methods for geophysical background feature site characterization related to UXO identification and discrimination.
    - Refine sensor/data fusion and analysis techniques to reduce nuisance and false alarms.
  - 95 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3916

**FY 1998 Planned Program:** Project not funded in FY 98

**FY 1999 Planned Program:** Project not funded in FY 99

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 0              | 0              | 0              | 0              |
| Appropriated Value                |                | 3916           |                |                |
| Adjustments to Appropriated Value |                |                |                |                |
| FY 1998 Pres Bud Request          | 0              | 3916           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997 - Congressional plus-up (+3916) for UXO applied research.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> |                     |                           |                     | PROJECT<br><b>A829</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A829 National Defense Center for Environmental Excellence (NDCEE) Technology  | 12516             | 12895               | 5269                | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 30680      |
| <p><b>A. <u>Mission Description and Justification:</u></b> The mission of the National Defense Center for Environmental Excellence (NDCEE) is to demonstrate and export new environmentally acceptable technology to the industrial base, train the industrial base on the use of the new technology, perform research and development, where necessary, to mature a new technology prior to demonstrating and export the technology to the industrial base. The NDCEE evaluates and validates alternative manufacturing materials, treatments and processes which comply with environmental and occupational health regulations. NDCEE is transitioning to self-sufficiency by FY 1999. The primary in-house development agency is the US Army Materiel Command's Armament Research, Development, and Engineering Center, Picatinny Arsenal, NJ.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 12516 - Maintained/upgraded environmental technology facility (flashjet, spongejet, carbon dioxide turbine wheel stripper, water recycle units, ion beam implanter, supercritical painting system); performed industrial base integration and environmental analyses.             <ul style="list-style-type: none"> <li>- Continued execution of Congressionally-directed efforts: plastic sortation, industrial health risk assessments, NitRem removal process demonstration, and Adams process investigation.</li> <li>- Demonstrated technology transfer and transition of: non-halogenated metal parts cleaning, electrodeposited coatings, powder coating demonstration, non-chrome conversion coatings, waterjet paint stripping, paint handling and spraying equipment, ion beam processing, material and process substitution program, and supercritical carbon dioxide (liquid) as a replacement for solvents in paint.</li> </ul> </li> </ul> <p>Total 12516</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7857 - Maintain/upgrade environmental technology facility (supercritical cleaning system, automatic plating, thermoplastic coatings, wet/dry blast booth, high velocity oxygen fuel spray, central water polishing unit); perform industrial base integration and environmental analyses.             <ul style="list-style-type: none"> <li>- Continue execution of Congressionally-directed efforts: industrial health risk assessments and NitRem removal process demonstration.</li> <li>- Demonstrate and transition: non-halogenated metal parts cleaning, electrodeposited coatings, powder coating demonstration, non-chrome conversion coatings, waterjet paint stripping, paint handling and spraying equipment, flashjet stripping, ion beam processing, material and process substitution program, cadmium plating alternatives, and supercritical carbon dioxide as a replacement for solvents in paint.</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |
| Project A829  |                   |                     | Page 8 of 19 Pages  |   |                     | Exhibit R-2 (PE 0602720A) |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
|---|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|------|------|---|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|-------|-------|------|---|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> |                              |                |                |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
|   | <b>PROJECT</b><br><b>A829</b>  |                              |                |                |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
| <ul style="list-style-type: none"> <li>• 4725 - Demonstrate and transition: new materials to help sustain the manufacturing base by exploiting waste products as a resource; simulations to speed the implementation process of new technologies into manufacturing processes; techniques to help designers decide on materials and processes for environmentally safe manufacturing; and techniques for teardown, disassembly, and reuse to eliminate open burning and open detonation as a means of disposal.</li> </ul> <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 313 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 12895</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5269 - Maintain environmental technology facility (pretreatment line, power washers, flashjet, honeycomb cleaner, carbon dioxide turbine wheel stripper, mobile treatment units, ion beam implanter, supercritical painting system, advanced immersion system, media booths, alternative plating line); perform industrial base integration and environmental analyses.</li> <li>- Continue to execute Congressionally-directed efforts: industrial health risk assessments and NitRem removal process demonstration.</li> <li>- Demonstrate and transition: non-chrome conversion coatings, waterjet paint stripping, paint handling and spraying equipment, ion beam processing, cadmium replacements, and supercritical carbon dioxide as a replacement for solvents in paint.</li> </ul> <p>Total 5269</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99. Program is to become self-sufficient in FY 1999.</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">12836</td> <td style="text-align: center;">8170</td> <td style="text-align: center;">5273</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">13196</td> <td style="text-align: center;">12895</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-680</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">12516</td> <td style="text-align: center;">12895</td> <td style="text-align: center;">5269</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 - Congressional plus-up (+4725).</p> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 12836 | 8170 | 5273 | 0 | Appropriated Value | 13196 | 12895 |  |  | Adjustments to Appropriated Value | -680 |  |  |  | FY 1998 Pres Bud Request | 12516 | 12895 | 5269 | 0 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
| FY 1997 President's Budget  | 12836  | 8170                         | 5273           | 0              |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
| Appropriated Value  | 13196  | 12895                        |                |                |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
| Adjustments to Appropriated Value   | -680   |                              |                |                |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
| FY 1998 Pres Bud Request  | 12516  | 12895                        | 5269           | 0              |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |
| Project A829  | Page 9 of 19 Pages   | Exhibit R-2 (PE 0602720A)    |                |                |                |                |                |                            |       |      |      |   |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |   |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> |                     |                     |                           | PROJECT<br><b>A835</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A835 Military Medical Environmental Criteria  | 2340              | 3103                | 3418                | 3308  | 3276                | 3744                | 3823                      | 4014                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project evaluates human health and environmental effects resulting from exposure to explosives, propellants, and smokes produced in Army industrial and field operations or disposed of through past activities. The end results of this research are determinations of acceptable residual concentration levels that will protect human health and the environment from adverse effects. The products of this research are US Environmental Protection Agency approved health advisories and criteria documents to be used in risk assessment procedures. These criteria are used by the Army during negotiations with regulatory officials to set scientifically and economically rational safe cleanup and discharge levels at Army installations. The primary developing laboratories are the US Army Biomedical Research and Development Laboratory (USABRDL), Ft. Detrick, MD, the Center for Health Promotion and Preventive Medicine (CHPPM), Edgewood, MD, and the Waterways Experiment Station (WES), Vicksburg, MS.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 929 - Continued development of munitions biomarkers and bioeffects (CHPPM).<br/>- Performed toxicological evaluation of munitions and degradation products (CHPPM).<br/>- Continued development of toxicity predictions using structure activity relationships and produced health advisories and criteria for military unique chemicals (CHPPM).</li> <li>• 1411 - Continued development of cross-species extrapolation of non-mammalian bioassays (USABRDL/CHPPM).<br/>- Continued development of fate and transport of military-unique compounds and developed microbial biomarkers (WES).<br/>- Continued identifying biomarkers to monitor bioattenuation of military-unique compounds and develop exposure models (WES).<br/>- Continued applying sentinel biomonitoring systems and applying methods for integrated environmental assessment of contaminated sites at Army installations (USABRDL).</li> </ul> <p>Total 2340</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2015 - Develop munitions biomarkers and bioeffects and conduct toxicological evaluation of munitions and degradation products (CHPPM).<br/>- Produce health advisories and criteria for military-unique chemicals and develop toxicity predictions using structure activity relationships (CHPPM).<br/>- Develop cross-species extrapolation of non-mammalian bioassays (USABRDL/CHPPM), apply sentinel biomonitoring systems (USABRDL), and apply methods for integrated environmental assessment of contaminated sites at Army installations (USABRDL).</li> <li>• 1012 - Develop fate and transport of military-unique compounds and microbial biomarkers (WES).<br/>- Identify biomarkers to monitor bioattenuation of military-unique compounds (WES).</li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project A835  |                   |                     | Page 10 of 19 Pages |   |                     |                     | Exhibit R-2 (PE 0602720A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> | <b>PROJECT</b><br><b>A835</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p align="center">- Develop exposure models and decision-making framework for ecological risk assessment (WES).</p> <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 76 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3103</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3418 - Develop munitions biomarkers and bioeffects and conduct toxicological evaluation of munitions and degradation products (CHPPM).<br/>                     - Produce health advisories and criteria for military-unique chemicals and develop toxicity predictions using structure activity relationships (CHPPM).<br/>                     - Develop cross-species extrapolation of non-mammalian bioassays (USABRDL/CHPPM), apply sentinel biomonitoring systems (USABRDL), and apply methods for integrated environmental assessment of contaminated sites at Army installations (USABRDL).<br/>                     - Develop fate and transport of military-unique compounds and microbial biomarkers (WES).<br/>                     - Identify biomarkers to monitor bioattenuation and effects of military-unique compounds (WES).<br/>                     - Develop exposure and effects models and decision-making framework for ecological risk assessment (WES).</li> </ul> <p>Total 3418</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3308 - Develop munitions biomarkers and bioeffects and conduct toxicological evaluation of munitions and degradation products (CHPPM).<br/>                     - Produce health advisories and criteria for military-unique chemicals and develop toxicity predictions using structure activity relationships (CHPPM).<br/>                     - Develop cross-species extrapolation of non-mammalian bioassays (USABRDL/CHPPM), apply sentinel biomonitoring systems (USABRDL), and apply methods for integrated environmental assessment of contaminated sites at Army installations (USABRDL).<br/>                     - Develop fate and transport of military-unique compounds and microbial biomarkers (WES).<br/>                     - Identify biomarkers to monitor bioattenuation and effects of military-unique compounds (WES).<br/>                     - Develop exposure and effects models and decision-making framework for ecological risk assessment (WES).</li> </ul> <p>Total 3308</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2179</td> <td style="text-align: center;">3169</td> <td style="text-align: center;">3416</td> <td style="text-align: center;">3304</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2240</td> <td style="text-align: center;">3103</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+100</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2340</td> <td style="text-align: center;">3103</td> <td style="text-align: center;">3418</td> <td style="text-align: center;">3308</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2179 | 3169 | 3416 | 3304 | Appropriated Value | 2240 | 3103 |  |  | Adjustments to Appropriated Value | +100 |  |  |  | FY 1998 Pres Bud Request | 2340 | 3103 | 3418 | 3308 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 2179   | 3169                          | 3416           | 3304           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 2240   | 3103                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | +100   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 2340   | 3103                          | 3418           | 3308           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project A835   |  | Exhibit R-2 (PE 0602720A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                            |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>A876</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| A876 Plasma Energy Pyrolysis System  | 0                 | 7343                | 0                          | 0  | 0                   | 0                   | 0                         | 0                             | 0                   | 7343       |
| <p><b>A. <u>Mission Description and Budget Item Justification:</u></b> This project provides a compliance and pollution control technology required to reduce the cost of treatment and disposal of hazardous and toxic site waste streams resulting from production or deactivation of military items or components. Plasma arc technology application enables the military to reduce the need for landfills and their future liability-related issues in a one step, safe, and economic process. The project will deliver an effective compliance technology to control and dispose of recalcitrant hazardous and toxic wastes regulated under Resource Conservation and Recovery Act amendments, in addition to satisfying the increasingly stringent emission standards of the Clean Air Act relevant to open burning/open detonation practices within the military. A plasma arc processing unit can reduce the significant costs associated with the many steps involved in other conventional hazardous waste treatment technologies, such as: sample characterization lead time, health and safety exposure risks to workers, and increased risks to the general public from accidents involving the excavated and transported wastes. The development and field demonstration of plasma arc technology will provide the user community with a much-needed tool for military hazardous waste processing and disposal on a flexible basis. In particular, developing a mobile unit's specifications, design, and blueprints will enable the Army, working with the Air Force, to converge on a mobile unit configuration and cut the time for field implementation.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7164 - Develop plans and permits for field demonstrations.</li> <li style="padding-left: 20px;">- Develop and characterize waste matrix guidelines.</li> <li style="padding-left: 20px;">- Design and procure mobile unit for field applications.</li> <li style="padding-left: 20px;">- Field demonstration.</li> <li>• 179 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 7343</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> |                   |                     |                            |  |                     |                     |                           |                               |                     |            |
| Project A876   |                   |                     | <i>Page 12 of 19 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0602720A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |                           |                |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> |                              |                           |                |
|   | <b>PROJECT</b><br><b>A876</b>  |                              |                           |                |
| <b><u>B. Project Change Summary</u></b>   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget  | 0  | 0                            | 0                         | 0              |
| Appropriated Value  |  | 7343                         |                           |                |
| Adjustments to Appropriated Value   |  |                              |                           |                |
| FY 1998 Pres Bud Request  | 0  | 7343                         | 0                         | 0              |
| Change Summary Explanation: Funding: FY1997 - Congressional plus-up (+7343) to develop plasma arc technology. |  |                              |                           |                |
|   |  |                              |                           |                |
| Project A876  | <i>Page 13 of 19 Pages</i>   |                              | Exhibit R-2 (PE 0602720A) |                |



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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> | <b>PROJECT</b><br><b>A877</b> |
|---|--|-------------------------------|

| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|---|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| A877 Western Environmental Technology Office<br>Environmental Support | 0                 | 4895                | 0                   | 0                   | 0                   | 0                   | 0                   | 0                   | 0                   | 4895       |

**A. Mission Description and Justification:** This Congressionally-directed effort with the Western Environmental Technology Office (WETO) provides for the transfer of environmental compliance technologies required to reduce the cost for treating hazardous and toxic pollutants from Army industrial operations which include Army ammunition plants, depots, and arsenals, and to help satisfy increasingly stringent environmental regulations on DoD and the Department of Energy (DOE). Those environmental requirements include wastewater discharge standards under the Clean Water Act and relevant State regulations, hazardous air pollutant emission standards under the Clean Air Act Amendments (CAAA), requirements under Federal Facilities Compliance Act and Resource Conservation and Recovery Act and other regulations. The US Army Construction Engineering Research Laboratories (CERL) works closely with the Industrial Operations Command (IOC) to transfer environmental compliance and pollution prevention technologies to IOC installations. This project will support the transfer of environmental technologies to IOC installations. This enables the Army to reduce environmental compliance costs and future environmental liability costs. The technology transfer projects under this project should result in model industrial operations with environmental compliance which will help accelerate technology transfer to similar industrial operations within DoD. The primary technology transfer agency is the US Army Construction Engineering Research Laboratories, Champaign, IL. WETO is a privatized former component of DOE (as of September 1996). WETO will evaluate and demonstrate technologies to help DOE meet a requirement to clean up its sites.

**FY 1996 Accomplishments:** Project not funded in FY 96.

**FY 1997 Planned Program:**

- 4775 - Engineering design and evaluation of technologies to remove and detoxify metals and energetics in wastewater.
    - Design and construction of hazardous air pollutant control technology.
    - Construction and evaluation of technologies to treat oily waste and solvents.
  - 120 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 4895

**FY 1998 Planned Program:** Project not funded in FY 98.

**FY 1999 Planned Program:** Project not funded in FY 99.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>                |  | DATE<br><b>February 1997</b> |                               |                |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>                         | <b>PE NUMBER AND TITLE</b><br><b>0602720A Environmental Quality Technology</b> |                              | <b>PROJECT</b><br><b>A877</b> |                |
| <b>B. <u>Project Change Summary</u></b>                                       | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u>                | <u>FY 1999</u> |
| FY 1997 President's Budget  | 0  | 0                            | 0                             | 0              |
| Appropriated Value  |  | 4895                         |                               |                |
| Adjustments to Appropriated Value   |  |                              |                               |                |
| FY 1998 Pres Bud Request  | 0  | 4895                         | 0                             | 0              |
| Change Summary Explanation: Funding: FY1997 - Congressional plus-up (+4895) . |  |                              |                               |                |
|   |  |                              |                               |                |
| Project A877  | Page 15 of 19 Pages  |                              | Exhibit R-2 (PE 0602720A)     |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> |                     |                     |                           | PROJECT<br><b>A896</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A896 Base Facility Environmental Quality  | 2436              | 7257                | 3067                | 4553  | 4336                | 4566                | 4610                      | 4762                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides the Army with the technical capability to protect and improve the biological and physical characteristics of fixed installation training and testing areas needed to sustain readiness while also conserving protected natural and cultural resources, including threatened and endangered species. Technology developed within this project will enable training and testing land users to match usage events and schedules to the capabilities of specific land areas, and will also provide advanced methods to restore lands damaged in readiness exercises. Efforts under this project will also enable the Army to prevent pollution in facilities base operations, and to comply with the myriad Federal, state and host country environmental regulations dealing with hazardous and non-hazardous water, wastewater, air emission, solid waste (including sediment discharge) and noise. An additional effort is the development of environmental monitoring and modeling capabilities to support environmentally sustainable installation lands and facilities. The primary developing agency is the US Army Construction Engineering Research Laboratories, Champaign, IL.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2436 - Developed automated system for selecting revegetation plant species in different ecological regions.</li> <li style="padding-left: 20px;">- Developed threatened and endangered species (TES) inventory and monitoring protocols.</li> <li style="padding-left: 20px;">- Developed guidelines for mitigating environmental impacts of lead-based paint removal.</li> <li style="padding-left: 20px;">- Developed simulation for predicting small arms range noise.</li> </ul> <p>Total 2436</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3344 - Develop Phase I plant succession model for training land carrying capacity.</li> <li style="padding-left: 20px;">- Develop TES Army wide status reporting system.</li> <li>• 3845 - Develop a Congressionally-mandated agriculture-based bioremediation capability (to be executed by Army Environmental Center).</li> <li style="padding-left: 20px;">- Initiate development of pollution prevention procedures for solvents, cleaners, and oil-water separation.</li> <li>• 68 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 7257</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3067 - Develop cause/effect relationships between training activities and impacts on threatened and endangered species.</li> <li style="padding-left: 20px;">- Complete addition of weather statistics and terrain effects on improved noise propagation models.</li> <li style="padding-left: 20px;">- Identify and characterize the mechanisms that cause volatile organic carbon emissions from solvent and petroleum product usage.</li> </ul> <p>Total 3067</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project A896  |                   |                     | Page 16 of 19 Pages |   |                     |                     | Exhibit R-2 (PE 0602720A) |                              |                     |            |

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|--|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> | PROJECT<br><b>A896</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•           4553 - Develop validated risk assessment models to determine the effects of Army activities on habitat disturbance.</li> <li>              - Provide knowledge, approach, and tools to match training land use and land capacity in selected ecoregions.</li> <li>              - Develop decision support methodologies for assessment and mitigation of maneuver training impacts on threatened and endangered species.</li> <li>              - Complete guidance for identifying pollution prevention alternatives for Army applications.</li> </ul> <p>Total           4553</p>   |   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2425</td> <td style="text-align: center;">3412</td> <td style="text-align: center;">4053</td> <td style="text-align: center;">5539</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2491</td> <td style="text-align: center;">7257</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-55</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2436</td> <td style="text-align: center;">7257</td> <td style="text-align: center;">3067</td> <td style="text-align: center;">4553</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY1997 - Congressional plus-up (+3845) to develop a Congressionally-mandated agriculture based bioremediation capability.</p> <p style="padding-left: 40px;">FY1998 - Funds reprogrammed (-986) to higher priority requirements.</p> <p style="padding-left: 40px;">FY1999 - Funds reprogrammed (-986) to higher priority requirements.</p> |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2425 | 3412 | 4053 | 5539 | Appropriated Value | 2491 | 7257 |  |  | Adjustments to Appropriated Value | -55 |  |  |  | FY 1998 Pres Bud Request | 2436 | 7257 | 3067 | 4553 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 2425  | 3412                         | 4053           | 5539           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 2491  | 7257                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -55   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 2436  | 7257                         | 3067           | 4553           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Project A896   | Page 17 of 19 Pages   | Exhibit R-2 (PE 0602720A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                |                  |                     |   |                  |                  |                           | DATE<br><b>February 1997</b> |                  |            |
|--|----------------|------------------|---------------------|---|------------------|------------------|---------------------------|------------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                |                  |                     | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> |                  |                  |                           | PROJECT<br><b>AF25</b>       |                  |            |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate    | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate             | Cost to Complete | Total Cost |
| AF25 Military Environmental Restoration Technology   | 1717           | 2579             | 3326                | 3507  | 3577             | 3715             | 3826                      | 3952                         | Continuing       | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides cost effective technologies required to clean up DoD hazardous waste sites, including active installations under the Installation Restoration Program, those indicated for closure under the DoD Base Realignment and Closure Program and the Formerly Used Defense Sites Program. The 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 several major areas: innovative and cost-effective site identification, characterization, and monitoring technologies; groundwater systems; treatment technologies to remediate soil and groundwater contaminated with military-unique contaminants such as explosives/energetics, chemical agents, heavy metals, and other organics. Emphasis is placed on the development of in-situ remediation technologies and real or near real-time sensing technologies. Development of existing technologies provides near-term solutions, while adding to the knowledge base applicable to successful development of more complex in-situ technologies. The primary developing agency is the US Army Engineer Waterways Experiment Station, Vicksburg, MS.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1441 - Provided improved analytical methods for hydrazine and field analysis techniques for nitrocellulose.               <ul style="list-style-type: none"> <li>- Began development of design criteria and assessment of in-situ and ex-situ physical processes for remediation of explosives/organics-contaminated soils.</li> <li>- Developed methods of assessing extraction techniques for metals-contaminated soils.</li> </ul> </li> <li>• 276 - Developed remediation technology modules for Groundwater Modeling Systems.               <ul style="list-style-type: none"> <li>- Conducted field demonstration of Site Characterization and Analysis Penetrometer System (SCAPS) analytical/sampler interface.</li> </ul> </li> </ul> <p>Total 1717</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2522 - Develop improved laboratory analytical methods for identifying organic contaminants in soils.               <ul style="list-style-type: none"> <li>- Demonstrate thermal desorption sampler for volatile organic compounds and solvent detection.</li> <li>- Complete design criteria and assessment of in-situ and ex-situ chemical processes for remediation of explosives/organics-contaminated soils.</li> <li>- Demonstrate physical separation technology for remediation of heavy metals-contaminated soils and test methods to predict mobility of metals.</li> </ul> </li> <li>• 57 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2579</p> |                |                  |                     |   |                  |                  |                           |                              |                  |            |
| Project AF25   |                |                  | Page 18 of 19 Pages |   |                  |                  | Exhibit R-2 (PE 0602720A) |                              |                  |            |

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|--|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602720A Environmental Quality Technology</b> | PROJECT<br><b>AF25</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3326 - Develop advanced soil sampler system as part of the SCAPS.</li> <li style="padding-left: 20px;">- Develop Groundwater Modeling System (GMS) Version 2, housing a remedial module with fate/transport packages for explosives and metals.</li> <li style="padding-left: 20px;">- Develop improved chemical analytical techniques for detecting and quantifying special organic compounds in complex media.</li> <li style="padding-left: 20px;">- Provide technical data package of advanced concepts for in-situ biological treatment of explosives-contaminated media.</li> <li style="padding-left: 20px;">- Develop chemical extraction technologies for heavy metals-contaminated soils.</li> </ul> <p>Total 3326</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3507 - Develop an enhanced instrumentation package for the SCAPS and continue development of on-site data visualization and analysis.</li> <li style="padding-left: 20px;">- Incorporate in-situ bioremediation and electrokinetics design modules into the GMS version 2 model.</li> <li style="padding-left: 20px;">- Continue development of advanced biological ex-situ (bioreactors) and in-situ treatment of contaminated soils and physical/chemical methods for groundwater.</li> </ul> <p>Total 3507</p> |   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1786</td> <td style="text-align: center;">2634</td> <td style="text-align: center;">3323</td> <td style="text-align: center;">5009</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1838</td> <td style="text-align: center;">2579</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-121</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1717</td> <td style="text-align: center;">2579</td> <td style="text-align: center;">3326</td> <td style="text-align: center;">3507</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1999 - Funds reprogrammed (-1502) to higher priority requirements.</p>   |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1786 | 2634 | 3323 | 5009 | Appropriated Value | 1838 | 2579 |  |  | Adjustments to Appropriated Value | -121 |  |  |  | FY 1998 Pres Bud Request | 1717 | 2579 | 3326 | 3507 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 1786  | 2634                         | 3323           | 5009           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 1838  | 2579                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -121  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 1717  | 2579                         | 3326           | 3507           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p>Project AF25 <span style="float: right;">Page 19 of 19 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0602720A)</span></p>  |   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602782A Command, Control, Communications Technology</b> |                     |                           |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 13130             | 14976               | 16838               | 18180   | 18120               | 18775                     | 19174               | 19588                        | Continuing          | Continuing |
| AH92 Communications Technology   | 8526              | 7863                | 9254                | 9925  | 9893                | 10251                     | 10469               | 10696                        | Continuing          | Continuing |
| A779 Command/Control (C2) and Platform Electronics Technology  | 4604              | 7113                | 7584                | 8255  | 8227                | 8524                      | 8705                | 8892                         | Continuing          | Continuing |
| <p><b>Mission Description and Budget Item Justification:</b> 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 command/control (C2) and platform electronics technology project (A779) is to expand scientific knowledge for demonstration of state-of-the-art technologies, including command/control and electronic systems/subsystems, performance reliability, maintainability, safety, survivability, and man-machine interface for all Army air and ground platforms, including soldier systems and equipment. 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), PE 0602783A (Computer and Software Technology) and PE 0603734A (Military Engineering Advanced 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.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |
| <i>Page 1 of 6 Pages</i>   |                   |                     |                     |   |                     | Exhibit R-2 (PE 0602782A) |                     |                              |                     |            |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602782A Command, Control, Communications Technology</b> |                     |                     |                           |                              | PROJECT<br><b>AH92</b> |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| AH92 Communications Technology   | 8526              | 7863                | 9254                | 9925   | 9893                | 10251               | 10469                     | 10696                        | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> The exploratory development efforts in this project focus on developing and leveraging/adapting commercial communications technologies required to meet the information needs of the Force XXI battlefield. Several of the efforts also provide supporting technology for the Digital Battlefield Communications Advanced Technology Demonstration (ATD), the Battlefield Information Transmission (BITS) strategy and several other ATDs. Key technologies being addressed include: the adaptation and implementation of asynchronous transfer mode (ATM) switching technology in a hostile mobile environment, the adaptation and interface with commercial Personal Communications Technology, development of realistic models for emerging communications systems in dynamic field environments, the development and application of several tactical antenna technologies, the development of photonic controls for phased array antennas, and the development of solutions to address problems associated with implementation of Mobile internet protocol (IP) spread across different IP nets. These efforts also directly support the Information Systems and Technology Defense Technology Objectives outlined in the Defense Technology Area Plan and the Advanced Battlespace Information Systems study.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4399 - Continued development of a broadcast ATM capability and monitoring and control function for mobile networks. Developed hierarchical video routing gateway to translate signaling between ATM and IP networks.             <ul style="list-style-type: none"> <li>- Developed prototype UHF conformal structurally embedded reconfigurable antenna technology (SERAT) antenna for aircraft application. Continued experimental development of structure tuned antenna switches.</li> <li>- Demonstrated prototype 16-element photonic integrated phase and amplitude controller (IPAC) for phased array antenna control. Initiated development of optical phase locked loop transmitter for optically controlled phased array antennas.</li> </ul> </li> <li>• 4127 - Demonstrated validity of improved spectrum efficiency modeling as it supports wide band data radios and high capacity trunk radio systems design and planning.             <ul style="list-style-type: none"> <li>- Developed and demonstrated prototype personal communications system (PCS) wireless private branch exchange (PBX) for support of digital battlefield communications ATD.</li> <li>- Developed range extension test bed and a tracking and reporting system (TRS).</li> <li>- Experimented with integration of a surrogate digital radio (SDR) in an aircraft platform and demonstrated color video routing.</li> </ul> </li> </ul> <p>Total 8526</p> <p><b>FY 1997 Planned Program:</b></p> |                   |                     |                     |  |                     |                     |                           |                              |                        |            |
| Project AH92   |                   |                     | Page 2 of 6 Pages   |  |                     |                     | Exhibit R-2 (PE 0602782A) |                              |                        |            |



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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)                                |  | DATE                      |
|--|--|---------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                                     |  | February 1997             |
| PE NUMBER AND TITLE<br><b>0602782A Command, Control, Communications Technology</b> |  | PROJECT<br><b>AH92</b>    |
| •  | 3848 - Complete development of optical phase locked loop (OPLL) transmitter for optically controlled phased array antennas. Demonstrate OPLL module and IPAC in 16-element Optically Controlled Phased Array Antenna.  |                           |
| <b>FY 1997 Planned Program: (continued)</b>  |  |                           |
|  | - Develop software for modeling communication systems for high capacity transmission on-the-move in a battlefield environment.   |                           |
|  | - Demonstrate advanced wireless PBX technology.  |                           |
|  | - Initiate development of a next generation PCS capability for the dismounted soldier by adapting commercial cellular code division multiple access (CDMA) and wide CDMA (W-CDMA) technology.  |                           |
| •  | 4015 - Demonstrate hierarchical video routing between ATM and IP multicast networks, and integrate broadcast protocol with the radio access point.   |                           |
|  | - Continue SERAT conformal antenna development/evaluation for helicopter application. Demonstrate optically activated antenna switch.  |                           |
|  | - Continue development of range extension and testing in conjunction with digital battlefield communications radio access point and high capacity trunk radio programs.  |                           |
|  | - Initiate technology development in support of C2 protect for information operations (IO), focusing on protection and detection of network attacks to the tactical internet.  |                           |
| Total  | 7863   |                           |
| <b>FY 1998 Planned Program:</b>  |  |                           |
| •  | 3499 - Develop solutions to address problems of mobile IP hosts spread across different IP nets in hostile environments. Analyze mobile ATM and resource allocation in mixed (ATM/IP/narrow integrated services digital network (N-ISDN)) networks.  |                           |
|  | - Integrate and evaluate/demonstrate a SERAT conformal antenna in a UH-60 configuration. Demonstrate a broadband antenna technology (2MHz-2GHz) for SpeakEasy applications. Initiate super high frequency (SHF) on the move (OTM) antenna positioner/tracker development and develop element topology for structure tuned VHF antenna. |                           |
| •  | 2965 - Initiate development of the final integrated photonic control system for single/multi panel phased arrays.  |                           |
|  | - Initiate efforts to expand the system performance models to include the emerging communications technologies and systems.  |                           |
| •  | 2790 - Implement data protocols in support of next generation soldier PCS.   |                           |
|  | - Integrate, evaluate, and demonstrate an end-to-end SHF surrogate satellite system concept. Initiate development of an on-board switching capability for the high capacity relay.   |                           |
|  | - Continue technology development for C2 Protect for Information operations (IO) with focus on providing network access protection for the tactical Internet.  |                           |
|  | - Enhance commercial PCS systems to provide cellular range extension. Demonstrate advanced networking capabilities using potential future digital radio technology in an airborne configuration  |                           |
| Total  | 9254   |                           |
| Project AH92   |  | Exhibit R-2 (PE 0602782A) |

| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602782A Command, Control, Communications<br/>Technology</b> | <b>PROJECT</b><br><b>AH92</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3990 -Continue development of solutions to address problems of mobile IP hosts spread across different IP nets in hostile environments. Investigate mobile ATM and resource allocation in mixed (ATM/IP/N-ISDN) networks.<br/>-Apply SERAT technology to ground environments, and experiment with structure-tuned antenna technology. Evaluate/demonstrate an SHF OTM satellite communications (SATCOM) self steering antenna capability.</li> <li>• 2983 - Complete development of the integrated photonic control system for single/multi panel phased arrays, and integrate/demonstrate on a single panel phased array antenna.<br/>- Continue efforts to expand the system performance models and provide virtual communications systems models that support man-in-the-loop evaluations.</li> <li>• 2952 - Demonstrate peer to peer CDMA PCS capability without base stations using handsets with attached host computers (supports next generation soldier PCS).<br/>- Continue development of protection techniques for the tactical Internet expanding the effort to address intrusion detection and host level protection.<br/>- Continue experimentation with commercial PCS technology and military backhaul for PCS for the digital battlefield communications advanced technology demonstration. Enhance commercial PCS waveforms to eliminate vulnerabilities.</li> </ul> <p>Total            9925</p> |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">8584</td> <td style="text-align: center;">8042</td> <td style="text-align: center;">9240</td> <td style="text-align: center;">9907</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">8830</td> <td style="text-align: center;">7863</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-304</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">8526</td> <td style="text-align: center;">7863</td> <td style="text-align: center;">9254</td> <td style="text-align: center;">9925</td> </tr> </tbody> </table>   |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 8584 | 8042 | 9240 | 9907 | Appropriated Value | 8830 | 7863 |  |  | Adjustments to Appropriated Value | -304 |  |  |  | FY 1998 Pres Bud Request | 8526 | 7863 | 9254 | 9925 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 8584  | 8042                          | 9240           | 9907           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 8830  | 7863                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -304  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 8526  | 7863                          | 9254           | 9925           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p>Project AH92 <span style="float: right;">Page 4 of 6 Pages      Exhibit R-2 (PE 0602782A)</span></p>  |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602782A Command, Control, Communications<br/>Technology</b> |                     |                     |                           |                              | PROJECT<br><b>A779</b> |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| A779 Command/Control (C2) and Platform Electronics<br>Technology  | 4604              | 7113                | 7584                | 8255   | 8227                | 8524                | 8705                      | 8892                         | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> The objective of this project is the exploration of new concepts and techniques in command/control and platform electronics integration to achieve new and enhanced military functional capabilities. Emphasis is on mission planning, rehearsal, execution and monitoring, precision navigation and landing, command and control, and integration with the evolving digital battlefield. New enabling technologies which support the current thrusts are also explored, such as advanced controls and displays, voice interactive technology, 3D visualization, decision aids and tactical planning aids, data transfer, distributed data bases advanced open system architectures, and visionic technology and integration concepts, which contribute to digitization of the battlefield and provide command and control on the move. The project serves as a direct technology feed to the following advanced warfighting experiments (AWEs), advanced technology demonstrations (ATDs), advanced concept technology demonstrations (ACTDs) and Defense technology objectives (DTOs): Task Force XXI (TF XXI) and Division (DIV) XXI AWEs, Battlespace Command and Control (BC2) ATD, Rapid Battlefield Visualization ACTD, Battlefield Awareness and Data Dissemination ACTD, Joint Countermine ACTD, Consistent Battlespace Understanding DTO; Forecasting, Planning, and Resource Allocation DTO; and Integrated Force Management DTO.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2240 - Developed and demonstrated GPS/sensor integration technologies, reducing the impact of GPS vulnerabilities.             <ul style="list-style-type: none"> <li>- Evaluated proposed improvements to digital terrain model (DTM) technologies via simulation.</li> <li>- Implemented alternative GPS satellite selection algorithms and validated performance for on/near ground level application (soldier, ground vehicle, helicopter at nap-of-the-earth).</li> </ul> </li> <li>• 2364 - Added environmental features to aircraft mission rehearsal (AMR) (clouds, fog , shadows, etc.), threat information (e.g. threat domes) and other objects as overlays to the real satellite images.             <ul style="list-style-type: none"> <li>- Conducted initial multi-sensor (inertial barometric, doppler, GPS) differential GPS precision approach and landing test while operating in the selective availability/anti-spoof (SA/AS) mode.</li> </ul> </li> </ul> <p>Total 4604</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4060 - Integrate improved DTM technology with a precision navigation system with enhanced electronic countermeasure protection.             <ul style="list-style-type: none"> <li>- Initiate development of a real-time multi-sensor differential GPS (DGPS) precision approach and landing concept to support operation during periods of temporary loss due to jamming or outages and including a data link to provide both secure and electronic counter-countermeasures capabilities.</li> </ul> </li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                        |            |
| Project A779  |                   |                     | Page 5 of 6 Pages   |  |                     |                     | Exhibit R-2 (PE 0602782A) |                              |                        |            |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) |  | DATE<br>February 1997 |                           |                |
|---|--|-----------------------|---------------------------|----------------|
| BUDGET ACTIVITY                                     | PE NUMBER AND TITLE  | PROJECT               |                           |                |
| <b>2 - Applied Research</b>                         | <b>0602782A Command, Control, Communications Technology</b>  | <b>A779</b>           |                           |                |
| <b>FY 1997 Planned Program: (continued)</b>         |  |                       |                           |                |
| •   | 3053 - Integrate emerging technologies to demonstrate concepts which significantly enhance battlespace awareness and enable commanders and their staffs to electronically interface to the battlespace in an effective and intuitive manner. Technologies to be integrated include: computer/graphics hardware to support real-time 3D rendering of information; hardware and algorithms to facilitate natural human/machine interfaces [natural language (NL), touch and gestures, and large screen displays]; and software to implement battle planning (BP) functions.  |                       |                           |                |
| Total   | 7113   |                       |                           |                |
| <b>FY 1998 Planned Program:</b>                     |  |                       |                           |                |
| •   | 3638 - Demonstrate platform positioning accurate to 1-3 meters to enhance situation awareness, in all environments (electronic counter measures, nap of earth (NOE)) with registration to digital terrain modeling. Conduct a technical evaluation of a real-time integrated DGPS/multi-sensor precision approach and landing system.  |                       |                           |                |
| •   | 3946 - Demonstrate a battlespace planning and visualization system that integrates emerging technologies with existing DoD systems to enhance battlespace awareness and facilitate tactical assessment, forecasting, information visualization, course of action analysis and other critical C2 functions. The resulting system will provide real time planning, rehearsal and monitoring capabilities to commanders, analysts and staff.  |                       |                           |                |
| Total   | 7584   |                       |                           |                |
| <b>FY 1999 Planned Program:</b>                     |  |                       |                           |                |
| •   | 3179 - Design and develop system configurations and prepare system specifications for the integration of the precision navigation system with visionic technology, imagery database, and terrain databases. Demonstrate to the user community an integrated real-time DGPS/multi-sensor landing system.  |                       |                           |                |
| •   | 5076 - Develop and demonstrate a battle planning and visualization (BPV) system that integrates multiple existing DoD systems with emerging planning and user interface technologies to enhance all-echelon battlespace awareness. The BPV system will provide real-time/ near real-time hyperlinks to multiple battlefield information sources and innovatively display and interact with commanders and staff to accelerate and improve the commander's nine-step planning process. Forecasting, continuous planning/scheduling, interactive 3-D exploration of the battlespace, voice interaction and other advanced capabilities will be provided and stressed in exercises and field experiments. |                       |                           |                |
| Total   | 8255   |                       |                           |                |
| <b>B. Project Change Summary</b>                    |  |                       |                           |                |
|   | <u>FY 1996</u>   | <u>FY 1997</u>        | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget                          | 4620   | 7265                  | 7739                      | 8017           |
| Appropriated Value                                  | 4748   | 7113                  |                           |                |
| Adjustments to Appropriated Value                   | -144   |                       |                           |                |
| FY 1998 Pres Bud Request                            | 4604   | 7113                  | 7584                      | 8255           |
| Project A779  | Page 6 of 6 Pages  |                       | Exhibit R-2 (PE 0602782A) |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602783A Computer and Software Technology</b> |                     |                           |                     |                              |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost   | 3843              | 6500                | 679                 | 337  | 1234                | 0                         | 0                   | 0                            | 0                   | 12593      |
| DY10 Computer and Information Science Technology  | 2099              | 2269                | 679                 | 337  | 1234                | 0                         | 0                   | 0                            | 0                   | 6618       |
| A094 Tactical Software Technology   | 1744              | 4231                | 0                   | 0  | 0                   | 0                         | 0                   | 0                            | 0                   | 5975       |
| <p><b><u>Mission Description and Budget Item Justification</u></b> : 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 real-time 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 and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. This program is managed primarily by the Army Research Laboratory (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.</p> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| <i>Page 1 of 5 Pages</i>  |                   |                     |                     |  |                     | Exhibit R-2 (PE 0602783A) |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                          | PE NUMBER AND TITLE<br><b>0602783A Computer and Software Technology</b> |                     |                           |                     | PROJECT<br><b>DY10</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| DY10 Computer and Information Science Technology   | 2099              | 2269                | 679                      | 337   | 1234                | 0                         | 0                   | 0                            | 0                   | 6618       |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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, where applicable, for Army systems software development and achieve significant software reuse across Department of Defense (DoD) systems. This project also includes the application of intelligent system techniques in such areas as medical and maintenance diagnostics. New techniques, which include fuzzy logic and neural networks, will allow for expansion of applications and an increased focus on predictive application. Both medical and maintenance diagnostics applications of intelligent systems techniques need exploration for identification of high payoff applications. Intelligent decision support has the potential for significant military impact in these areas. 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2099 - Identified candidate medical and maintenance diagnostics applications of advanced intelligent systems techniques.             <ul style="list-style-type: none"> <li>- Demonstrated the capabilities of self-describing databases for direct database to database information exchange using the U.S. message text formats.</li> <li>- Created an electronic meeting system (EMS) environment that can be accessed by geographically distributed users over the Internet or dial-up modem.</li> <li>- Began to transition the computer aided prototyping system (CAPS) rapid prototyping environment into the Army Materiel Command life cycle software engineering centers and other software development agencies.</li> </ul> </li> </ul> <p>Total 2099</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2236 - Develop prototype medical and maintenance diagnostics applications using intelligent system techniques.             <ul style="list-style-type: none"> <li>- Develop concepts to be used in formulating DoD policy and in developing or procuring systems for a unified DoD records management process.</li> </ul> </li> </ul> |                   |                     |                          |   |                     |                           |                     |                              |                     |            |
| Project DY10   |                   |                     | <i>Page 2 of 5 Pages</i> |   |                     | Exhibit R-2 (PE 0602783A) |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|-----|-----|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602783A Computer and Software Technology</b> | <b>PROJECT</b><br><b>DY10</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |
| <p>- Extend records management research to incorporate data warehousing concepts and techniques into Army information systems and C3I applications.</p> <p>- Develop testbed for the creation, testing, and analysis of computer and information-based technologies in system design and evolution to meet warfighter information requirements.</p> <p><b>FY 1996 Accomplishments: (continued)</b></p> <p>- Use group systems in a distributed mode with one or more Army commands.</p> <p>33 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</p> <p>Total 2269</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 350 -Develop executable protocol specifications for and model the asynchronous transfer mode (ATM) protocol using very high speed integrated circuit hardware development language (VHDL).</li> <li>• 329 -Incorporate fully developed design database into distributed CAPS environment.</li> </ul> <p>Total 679</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 337 -Integrate change/merge capability for software subsystems into rapid prototyping testbed.</li> </ul> <p>Total 337</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2134</td> <td style="text-align: center;">2317</td> <td style="text-align: center;">2501</td> <td style="text-align: center;">2585</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2194</td> <td style="text-align: center;">2269</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-95</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2099</td> <td style="text-align: center;">2269</td> <td style="text-align: center;">679</td> <td style="text-align: center;">337</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1998 funding reprogrammed (-1822) to higher priority requirements.<br/>FY 1999 funding reprogrammed (-2248) to higher priority requirements.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2134 | 2317 | 2501 | 2585 | Appropriated Value | 2194 | 2269 |  |  | Adjustments to Appropriated Value | -95 |  |  |  | FY 1998 Pres Bud Request | 2099 | 2269 | 679 | 337 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |
| FY 1997 President's Budget   | 2134   | 2317                          | 2501           | 2585           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |
| Appropriated Value   | 2194   | 2269                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |
| Adjustments to Appropriated Value  | -95  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |
| FY 1998 Pres Bud Request   | 2099   | 2269                          | 679            | 337            |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |
| Project DY10   | Page 3 of 5 Pages  | Exhibit R-2 (PE 0602783A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |     |     |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602783A Computer and Software Technology</b> |                     |                           |                     | PROJECT<br><b>A094</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A094 Tactical Software Technology  | 1744              | 4231                | 0                   | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 5975       |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project addresses the development of software techniques to exploit the rapid advances in computer (hardware) performance that are 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 soldier 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. It identifies the necessary functions for a simulation capability that supports the evaluation of C4I battlefield architectures and digitization and communications science technologies for operational utility and predicted technical performance. This project seeks to develop the computational technology to achieve efficient utilization of advanced computer architectures at the tactical level. This project reflects movement of funds within ARL due to the Federated Laboratory Restructuring.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1744 - Concluded research and development of adaptive information distribution and incorporated into prototype software. Provided real-time display of network performance. Evaluated success of approach under field conditions and transitioned to Combined Arms Command and Control Advanced Technology Demonstration. <ul style="list-style-type: none"> <li>- Demonstrated testing of executable specifications using VHDL.</li> <li>- Developed techniques to passively monitor an automated information distribution environment to develop statistics to support research into heuristics to maximize network throughput, minimize network delay and respond to anomalies in network performance.</li> </ul> </li> </ul> <p>Total 1744</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4197 - Demonstrate synthesis of communication interfaces using Very High Speed Integrated Circuit (VHSIC) Hardware Descriptive Language. <ul style="list-style-type: none"> <li>- Incorporate heuristics of network performance into software and transition to the Communication and Electronics Command Technology Demonstration.</li> <li>- Develop software to support reasoning at multiple levels of abstraction which cooperatively process information from multiple heterogeneous databases.</li> <li>- Conduct research to advance the science of rendering complex terrain, abstract data and battlefield objects in 3-D to avoid clutter and perceptual and cognitive overload.</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |
| Project A094   |                   |                     | Page 4 of 5 Pages   |   |                     | Exhibit R-2 (PE 0602783A) |                     |                              |                     |            |



| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
|---|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602783A Computer and Software Technology</b> | PROJECT<br><b>A094</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
| <p><b>FY 1997 Planned Program (continued):</b><br/>             34 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.<br/>         Total       4231</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p>  |   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">1749</td> <td style="text-align: center;">4321</td> <td style="text-align: center;">4798</td> <td style="text-align: center;">5524</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">1798</td> <td style="text-align: center;">4231</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-54</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1744</td> <td style="text-align: center;">4231</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: Beginning in FY 1998, funds reprogrammed to other Army requirements, in compliance with Army Science Board recommendation to increase reliance on commercial sources for advanced software technology.</p> |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1749 | 4321 | 4798 | 5524 | Appropriated Value | 1798 | 4231 |  |  | Adjustments to Appropriated Value | -54 |  |  |  | FY 1998 Pres Bud Request | 1744 | 4231 | 0 | 0 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
| FY 1997 President's Budget  | 1749  | 4321                         | 4798           | 5524           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
| Appropriated Value  | 1798  | 4231                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
| Adjustments to Appropriated Value   | -54   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
| FY 1998 Pres Bud Request  | 1744  | 4231                         | 0              | 0              |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |
| Project A094  | Page 5 of 5 Pages   | Exhibit R-2 (PE 0602783A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |   |   |

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|---|----------------|------------------|------------------|--|------------------|------------------|------------------|-----------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                |                  |                  | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> |                  |                  |                  |                       |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate      | Cost to Complete | Total Cost |
| Total Program Element (PE) Cost   | 33734          | 38060            | 36422            | 40112  | 40322            | 40691            | 41767            | 42888                 | Continuing       | Continuing |
| A855 Topography, Image Intelligence, and Space Technology   | 7729           | 8377             | 8929             | 9719   | 9487             | 9837             | 10051            | 10373                 | Continuing       | Continuing |
| AH71 Atmospheric Investigations   | 5214           | 6551             | 5872             | 6135   | 6142             | 6406             | 6689             | 6885                  | Continuing       | Continuing |
| AT40 Mobility & Weapons Effects Technology  | 10326          | 11140            | 12157            | 13751  | 13731            | 14230            | 14532            | 14850                 | Continuing       | Continuing |
| AT41 Military Facilities Engineering Technology   | 4313           | 4195             | 3479             | 4376   | 4259             | 4033             | 4239             | 4348                  | Continuing       | Continuing |
| AT42 Cold Regions Engineering Technology  | 4186           | 5425             | 3647             | 3567   | 3949             | 3634             | 3746             | 3862                  | Continuing       | Continuing |
| AT45 Energy Technology Applied to Military Facilities   | 1966           | 2372             | 2338             | 2564   | 2754             | 2551             | 2510             | 2570                  | Continuing       | Continuing |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> The applied research conducted in this program provides technology in direct support of critical warfighter functions of mobility, countermobility, survivability, sustainment engineering, and topography needed to win on the modern battlefield. Research is conducted that supports the special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Key operational technologies developed are demonstrated to Army units under program element 0603734A (Military Engineering Advanced Technology). Results are tailored to support the material development, test, and acquisition community in evaluating the impacts of weather, terrain, and atmospheric obscuration on military operations. Research develops and exploits a wide range of innovative technologies and applies them to Defense unique planning, acquisition, revitalization, and sustainment processes. The goal of this research is to improve the efficiency and cost effectiveness as it relates to supporting the training/readiness/force projection missions in garrison and force sustainment missions in theaters of operation. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Defense Reliance Agreements on Civil Engineering and Battlespace Environments with oversight provided by the Joint Directors of Laboratories and Joint Engineers. These projects include non-system specific development efforts toward specific military needs and are therefore appropriate to Budget Activity 2.</p> |                |                  |                  |  |                  |                  |                  |                       |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> |                     |                     |                           | PROJECT<br><b>A855</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A855 Topography, Image Intelligence, and Space Technology   | 7729              | 8377                | 8929                | 9719   | 9487                | 9837                | 10051                     | 10373                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 7729 - Developed a semi-automatic knowledge based feature extraction and attribution capability.</li> <li style="padding-left: 20px;">- Developed an integrated virtual reality interface to the synthetic environment visualization system enabling soldiers to immerse in fog, haze, dust, clouds, smoke, flares, minefields, craters, and penetrable buildings.</li> <li style="padding-left: 20px;">- Developed 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.</li> <li style="padding-left: 20px;">- Developed and implemented capabilities of identification of man-made materials from hyperspectral data and signature data bases.</li> </ul> <p>Total 7729</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 8377 - Develop a DoD standard coordinate conversion and datum transformation software package.</li> <li style="padding-left: 20px;">- Develop rapid, dynamic, 3-D battlefield environment/terrain visualization capabilities in a virtual reality environment for tactical and training applications.</li> <li style="padding-left: 20px;">- Develop distributed interactive simulation (DIS) browser supporting dynamic changes during simulation.</li> <li style="padding-left: 20px;">- Develop software and techniques for the identification of man-made materials using far infrared, hyperspectral data.</li> </ul> <p>Total 8377</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project A855  |                   |                     | Page 2 of 15 Pages  |  |                     |                     | Exhibit R-2 (PE 0602784A) |                              |                     |            |

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|--|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> | PROJECT<br><b>A855</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 8929 - Develop initial capability for automated feature attribution based on multispectral imagery data.             <ul style="list-style-type: none"> <li>- Link 3-D model and texture library to database generation capability.</li> <li>- Develop parametric modeling capability for battlefield terrain simulation.</li> <li>- Develop procedures for ensuring that mapping, charting, and geodesy (MC&amp;G) software adheres to the Defense Information Infrastructure.</li> <li>- Develop new methods for portraying terrain analysis product reliability.</li> </ul> </li> </ul> <p>Total 8929</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9719 - Develop automated feature extraction techniques and software.             <ul style="list-style-type: none"> <li>- Integrate dynamic terrain architecture and synthetic environment models into a DIS stealth module.</li> <li>- Develop standardized Army-wide MC&amp;G software verification and validation procedures.</li> <li>- Combine spatial recognition software and techniques with hyperspectral recognition software and techniques in a single testbed.</li> </ul> </li> </ul> <p>Total 9719</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">7922</td> <td style="text-align: center;">8556</td> <td style="text-align: center;">8915</td> <td style="text-align: center;">9700</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">8142</td> <td style="text-align: center;">8377</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-413</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">7729</td> <td style="text-align: center;">8377</td> <td style="text-align: center;">8929</td> <td style="text-align: center;">9719</td> </tr> </tbody> </table> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 7922 | 8556 | 8915 | 9700 | Appropriated Value | 8142 | 8377 |  |  | Adjustments to Appropriated Value | -413 |  |  |  | FY 1998 Pres Bud Request | 7729 | 8377 | 8929 | 9719 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 7922   | 8556                         | 8915           | 9700           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 8142   | 8377                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -413   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 7729   | 8377                         | 8929           | 9719           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project A855   | Page 3 of 15 Pages   | Exhibit R-2 (PE 0602784A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> |                     |                           |                     | PROJECT<br><b>AH71</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AH71 Atmospheric Investigations   | 5214              | 6551                | 5872                | 6135   | 6142                | 6406                      | 6689                | 6885                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 joint programs. The work is managed by the Army Research Laboratory (ARL), Battlefield Environment Directorate, White Sands Missile Range, New Mexico.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3370 - Developed the capability for the Integrated Weather Effects Decision Aid (IWEDA) to use Battlespace Forecast Model field output, and to operate on Army common hardware.             <ul style="list-style-type: none"> <li>- Exploited tactical geosynchronous meteorological satellite receiver technology to improve temporal resolution of battlefield/target area weather data.</li> <li>- Developed prototype mobile profiling system (MPS) to be more deployable; improved MPS satellite profiles; and performed cost benefit analysis of mesoscale model for artillery accuracy.</li> </ul> </li> <li>• 1844 - Developed user interface for 2-dimensional limited complex terrain acoustic propagation model and integrated into real-time system architecture.             <ul style="list-style-type: none"> <li>- Integrated realistic hazard predictions from chemical-biological agent into war game models and visualization environment.</li> </ul> </li> </ul> <p>Total 5214</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4425 - Complete the horizontal and seamless integration of the Integrated Weather Effects Decision Aid (IWEDA) into battlefield automated systems (BASs).             <ul style="list-style-type: none"> <li>- Develop an initial capability to forecast precipitation over the battlefield at tactical scales and add 4-D data assimilation and meteorological satellite initialization capability to the Battlescale Forecast Model.</li> <li>- Develop a prototype 4-D computer assisted artillery meteorology software system which provides trajectory and target area meteorology for close and deep attack systems; and develop a proof-of-concept downsized mobile profiling system.</li> </ul> </li> <li>• 2066 - Develop user interface for 2-dimensional limited complex terrain acoustic propagation model.</li> </ul> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| Project AH71  |                   |                     | Page 4 of 15 Pages  |  |                     | Exhibit R-2 (PE 0602784A) |                     |                              |                     |            |

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|---|--|------------------------------|
| BUDGET ACTIVITY   | PE NUMBER AND TITLE  | PROJECT                      |
| <b>2 - Applied Research</b>   | <b>0602784A Military Engineering Technology</b>  | <b>AH71</b>                  |
| <ul style="list-style-type: none"> <li>- Adapt direct numerical simulations for operational chemical/biological hazard modeling.</li> <li>- Enhance real-time scene visualization data transformation and rendering algorithms to support the integration of battlefield environment data in situation awareness displays.</li> </ul> |  |                              |
| <b>FY 1997 Planned Program: (continued)</b>   |  |                              |
| •   | 60 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                              |
| Total   | 6551   |                              |
| <b>FY 1998 Planned Program:</b>   |  |                              |
| •   | 3304 - Extend the battlescale forecast model (BFM) forecast period to 48 hours and increase forecast accuracy by initializing with higher resolution Air Force or Navy model data.<br>- Develop the capability for the All Source Analysis System, the Digital Topographic Support System, the Advanced Mobile Profiling System, and the Maneuver Control System to concurrently retrieve and incorporate weather information in Intelligence Preparation of the Battlefield, trafficability, aviation, and nuclear/biological/chemical applications.<br>- Incorporate additional friendly and threat systems into the IWEDA data base.<br>- Convert the Electro-Optical Tactical Decision Aids including weapon zones, target acquisition ranges, and thermal reversal to distributed client/server applications. |                              |
| •   | 2568 - Demonstrate the accuracy achieved by moving the battlescale forecast model (BFM) from the meteorology measuring set to indirect fire control computers and using the BFM to correct for met effects over the entire trajectory path of a projectile.<br>- Develop a decision aid for displaying sound levels as a function of range and direction in the 2-dimensional turbulent boundary layer over flat terrain.<br>- Examine and devise computationally efficient algorithms for dynamic weather data transformations for parallel and scaleable processing architectures with the dynamic terrain data transformations developed in this PE under Project A855.   |                              |
| Total   | 5872   |                              |
| <b>FY 1999 Planned Program:</b>   |  |                              |
| •   | 3436 - Evaluate converting the BFM to a nonhydrostatic model to improve predictions of severe weather.<br>- Enhance forecaster decision aids with improved algorithms for predicting icing, turbulence, visibility, low cloud, and precipitation.<br>- Transition an acoustic detection tactical decision aid using the BFM output to enable troops to determine the optimum placement of acoustic sensors for threat detection and optimum avenues of attack based on acoustic emissions and atmospheric conditions.<br>- Incorporate an improved BFM for forecast representations in combat simulation and training including clouds, fog, severe weather, and improved battlefield aerosol diffusion at tactical scales.  |                              |
| •   | 1595 - Conduct evaluation of the system for target area and trajectory meteorology for close and deep attack systems and implement changes as needed; begin insertion of software upgrades such as improved satellite sounding retrievals.   |                              |
| Project AH71  | <i>Page 5 of 15 Pages</i>  | Exhibit R-2 (PE 0602784A)    |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> | PROJECT<br><b>AH71</b>       |                |                |
| <ul style="list-style-type: none"> <li>• 1104 - Develop a user interface for 2-dimensional limited complex terrain/acoustic propagation model.</li> </ul> <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Use transient turbulence theory to develop a high resolution, complex terrain transport and diffusion model which will permit simultaneous calculation of meteorology and hazards prediction with significantly reduced computation time through eliminating the stepwise procedure of traditional approaches.</li> <li>- Investigate visualization techniques for fusing multiple information sources into a unified visualization of weather with the rapid, dynamic, 3-D battlefield environment/terrain visualization capabilities being developed in this PE under Project A855.</li> </ul> <p>Total            6135</p> |  |                              |                |                |
| <b>B. <u>Project Change Summary</u></b>   |  |                              |                |                |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget  | 5270   | 6691                         | 5865           | 6125           |
| Appropriated Value  | 5416   | 6551                         |                |                |
| Adjustments to Appropriated Value   | -202   |                              |                |                |
| FY 1998 Pres Bud Request  | 5214   | 6551                         | 5872           | 6135           |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> |                     |                     |                           | PROJECT<br><b>AT40</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AT40 Mobility & Weapons Effects Technology   | 10326             | 11140               | 12157               | 13751  | 13731               | 14230               | 14532                     | 14850                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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&amp;T) in this project directly supports the Army's DoD Project Reliance S&amp;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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5330 - Determined pressure/sinkage algorithms that account for soil's cyclic remolding produced by multiple vehicle passages; validated and documented mobility data inference routines for the world's major climatic zones.             <ul style="list-style-type: none"> <li>- Conducted two-dimensional laboratory experiments of concepts for rapidly emplaced breakwaters; incorporated engineer workload determination and resource allocation in theater infrastructure planning and assessment model.</li> <li>- Performed subscale experiments of robust penetrators against layered targets; developed vulnerability analysis computer code for field evaluation and developed methodology and database for designing construction components to resist "very low" and "low" forced entry threat levels; developed analytical procedures for predicting component delay times to "medium" threat severity.</li> </ul> </li> <li>• 4996 - Conducted field evaluations of lightweight expedient surfacing for contingency operating surfaces and developed design and construction guidance for pavement joints and pavement smoothness; completed critical pavement durability parameter investigations.             <ul style="list-style-type: none"> <li>- Evaluated concepts for deployable protective field fortifications for light forces; determined applicability of existing terrorist threat countermeasures for deploying forces and provided fully dynamic 3-D environmental information base procedures for infrared (IR) signatures; developed Camouflage, Cover, and Deception (CCD) measures for Army aviation fixed/long-dwell facilities.</li> <li>- Developed precise techniques to predict the effects of localized, point-of-attack target damages on entire structures; conducted field experiments of assault breaching and obstacle creation technologies and developed and integrated knowledge-based decision making algorithms for obstacle placement into obstacle planning software (OPS).</li> </ul> </li> </ul> <p>Total      10326</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project AT40   |                   |                     | Page 7 of 15 Pages  |  |                     |                     | Exhibit R-2 (PE 0602784A) |                              |                     |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602784A Military Engineering Technology</b> | <b>PROJECT</b><br><b>AT40</b> |
| <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            5857 - Complete development of first generation robust theoretical mobility model incorporating non-linear vehicle-terrain interaction; complete development of automated methods to rapidly derive, from standard available data, world-wide high-resolution mobility model input data.               <ul style="list-style-type: none"> <li>- Conduct 3-D, lab-scale experiments of rapidly emplaced breakwater concepts to support logistics-over-the-shore operations.</li> <li>- Develop design criteria for complex layered antipenetration systems to defeat large penetrating munitions and develop methodology for designing construction components to resist forced entry.</li> </ul> </li> <li>•            5283 - 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 and synthesize theoretical equations, laboratory experiment results, and field data into a preliminary interactive analytical pavement response and performance model.               <ul style="list-style-type: none"> <li>- Complete protective concepts for US Army aircraft parked in forward battle areas, criteria and guidance for the protection of deploying forces from sabotage attack, and concepts for protective shelters packages for light forces and conduct fixed/long-dwell facility decoys experiments.</li> <li>- Develop techniques to predict demolition's effects on reinforced concrete and rock structural targets and evaluate integrated obstacle planning software (OPS) algorithms during a full-scale field training exercise.</li> </ul> </li> </ul> <p>Total            11140</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            12157 - Develop simplified survivability analysis procedure for field fortifications; develop camouflage materials and light-weight material revetments for protection of aviation assets; develop designs for fixed/long-dwell facility decoys.               <ul style="list-style-type: none"> <li>- Develop improved analytic procedures for predicting reflections from geologic layers and the ground surface due to subsurface detonations; develop and validate hardening techniques for walls to resist mortar threats.</li> <li>- Conduct 3-D lab-scale experiments of rapidly emplaced breakwater concepts for logistics-over-the-shore operations; develop initial methodology for rapid generation of river basin models for hydrologic forecasting.</li> <li>- Develop advanced pavements materials characterization and classification procedures; develop and validate algorithms to predict performance of expedient airfield pavements.</li> <li>- Validate algorithms to infer structural attributes that are not available but required for bridge assessments; develop techniques for rapid soils properties determination; evaluate techniques for rapid repair of damaged bridges; develop model to predict roadway deterioration under military unique loads in emerging countries.</li> <li>- Initiate development of algorithms for rainfall distribution effects on soil moisture/strength and vehicle traction; reconfigure NATO Reference Mobility Model for replication of dynamic deformable soil-tire/track interactions; evaluate epoxy/polymer materials for expedient strengthening of roadway surfaces.</li> </ul> </li> </ul> <p>Total            12157</p> |   |                               |
| <p>Project AT40 <span style="float: right;">Page 8 of 15 Pages      Exhibit R-2 (PE 0602784A)</span></p>  |   |                               |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b> | <b>PE NUMBER AND TITLE</b><br><b>0602784A Military Engineering Technology</b> | <b>PROJECT</b><br><b>AT40</b> |
|---|---|-------------------------------|

**FY 1999 Planned Program:**

- 13751 - Develop techniques for troop evaluations of the structural integrity of small protective emplacements; evaluate concepts for application of multispectral CCD material combinations to fixed/long-dwell assets; correlate target structural damage with target type, geometry, and materials and demolition method.
- Develop integrated procedures for the design and analysis of above-ground and buried facilities to resist both external and internal detonations; complete static and dynamic laboratory experiments and associated analyses of square concrete structural components with large span-to-thickness ratios; develop and validate hardening techniques for roofs to resist mortar threats.
- Design specifications for rapidly installed breakwater; incorporate algorithms into Riverine Analysis Model to calculate probability bands for hydrologic predictions; incorporate real-time nowcast data analyses into logistics-over-the-shore planning model.
- Establish criteria and procedures for the use of local materials and equipment for construction of expedient airfields; validate analytic models capable of replicating dynamic pavements and materials response under vehicle loadings and multiple tire interactions.
- Develop an analytic capability for automated assessment and load classification of bridges; establish procedures for use of soil vitrification for soil stabilization; complete initial software for synergistic allocation of engineer assets within resource constraints to transportation infrastructure maintenance, repair, and construction tasks.
- Develop soil constitutive relationships describing the traction performance of tires operating in coarse-grained soils; develop stress distribution model for tire/track/soil contact area; conduct in-situ field experiments to measure normal and tangential forces occurring at the vehicle/soil interface.

Total 13751

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 10520          | 11403          | 12642          | 13756          |
| Appropriated Value                | 10812          | 11400          |                |                |
| Adjustments to Appropriated Value | -486           |                |                |                |
| FY 1998 Pres Bud Request          | 10326          | 11140          | 12157          | 13751          |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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| BUDGET ACTIVITY<br><b>2 - Applied Research</b> | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> | PROJECT<br><b>AT41</b> |
|--|--|------------------------|

| COST (In Thousands)                             | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| AT41 Military Facilities Engineering Technology | 4313           | 4195             | 3479             | 4376             | 4259             | 4033             | 4239             | 4348             | Continuing       | Continuing |

**A. Mission Description and Justification:** This project exploits innovative developments in a wide range of technologies to achieve critically needed cost reductions in Army facility life cycle processes (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal). Current Army infrastructure operations, maintenance, and repair costs alone are about \$8.5 billion per year. The goal for the DoD Technology Area Plan is to reduce facility acquisition and maintenance and repair costs 15% by FY 2001 from a 1985 baseline. Meeting this critical goal is not possible without application of significant technology innovation. Products already developed and projected for the future have high civilian sector dual use potential. These include innovations in composite materials, concurrent engineering, collaborative decision support, corrosion resistant coatings, seismic vulnerability evaluations, and knowledge processing. Additionally, significant soldier retention benefits also accrue from providing professional work environments and high quality communities for military families. Under the DoD Project Reliance initiative, the Army is responsible for managing the conventional facilities research and development needs of all the military services through the Construction Engineering Research Laboratories, Champaign, Illinois.

- FY 1996 Accomplishments:**
- 2610 - Developed building engineering management system to provide holistic decision support for building maintenance and repair.
    - Evaluated smart roofing systems and construction materials recycling for design, repair and revitalization of Army facilities.
    - Developed concurrent engineering environment for facility design and construction to improve life cycle decision making.
  - 1703 - Tested pre-cast concrete wall connectors for seismic retrofit.
    - Provided collaborative performance support environment for knowledge workers to improve installation management.
- Total 4313

- FY 1997 Planned Program:**
- 4195 - Integrate installation commanders' facility maintenance management system data warehouses for optimal resource allocation with special emphasis on automated inspection procedures.
    - Demonstrate concurrently engineered facility delivery process that facilitates multiple discipline interaction.
    - Develop criteria for recycling construction and demolition materials.
    - Develop conductive concrete for electromagnetic shielding applications for secure facilities.
- Total 4195

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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602784A Military Engineering Technology</b> | <b>PROJECT</b><br><b>AT41</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3479 - Demonstrate the Open Collaborative Engineering framework for modular design and integrated military facility management.</li> <li style="padding-left: 20px;">- Initiate development of ferromagnetic active tags to monitor status of military structural building systems.</li> <li style="padding-left: 20px;">- Develop seismic evaluations and rehabilitation methods for military steel frame buildings.</li> </ul> <p>Total 3479</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4376 - Enhance the Modular Design for Systems to accommodate 80% of Army facility types.</li> <li style="padding-left: 20px;">- Initiate development of self-repairing facings, coatings, and membranes for military buildings containing distributed reactive materials in inert casings which when released enable self-repair.</li> <li style="padding-left: 20px;">- Develop criteria for upgrading seismically vulnerable concrete frame barracks structures.</li> <li style="padding-left: 20px;">- Document effectiveness of isolation and strengthening methods for protecting critical equipment.</li> </ul> <p>Total 4376</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4332</td> <td style="text-align: center;">4285</td> <td style="text-align: center;">3965</td> <td style="text-align: center;">4358</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4453</td> <td style="text-align: center;">4195</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-140</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4313</td> <td style="text-align: center;">4195</td> <td style="text-align: center;">3479</td> <td style="text-align: center;">4376</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding- FY1998 funding reprogrammed (-486) to higher priority requirements.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4332 | 4285 | 3965 | 4358 | Appropriated Value | 4453 | 4195 |  |  | Adjustments to Appropriated Value | -140 |  |  |  | FY 1998 Pres Bud Request | 4313 | 4195 | 3479 | 4376 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 4332  | 4285                          | 3965           | 4358           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 4453  | 4195                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -140  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 4313  | 4195                          | 3479           | 4376           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AT41  | Page 11 of 15 Pages   | Exhibit R-2 (PE 0602784A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> |                     |                     |                           | PROJECT<br><b>AT42</b> |                     |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate    | Cost to<br>Complete | Total Cost |
| AT42 Cold Regions Engineering Technology  | 4186              | 5425                | 3647                | 3567   | 3949                | 3634                | 3746                      | 3862                   | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 construction, operation and maintenance. Research directly lowers high life-cycle costs and extends the abbreviated service life of DoD facilities and provides the basis for extending the operability of forces and materiel in cold weather. 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 remote/high altitude environments. This program is a source of special technologies for civilian engineering and environmental applications not obtainable through the private sector and is essential to improving US projection of power and operational capabilities in cold weather areas of the world. The work is managed by the US Army Cold Regions Research and Engineering Laboratory, Hanover, NH.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4186 - Validated millimeter-wave radar backscatter model, and demonstrated dynamic scene rendering for the Smart Weapons Operability Enhancement (SWOE) Science and Technology Objective (STO).               <ul style="list-style-type: none"> <li>- Integrated deep snow model into the Comprehensive Army Mobility Model System (CAMMS); created cold weather effects data bases for Janus wargame analysis model.</li> <li>- Developed prototype 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 programs.</li> </ul> </li> </ul> <p>Total 4186</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4541 - Complete integrated mobility modeling for snow, thawing soil and surface icing conditions for engineer mission analysis.               <ul style="list-style-type: none"> <li>- Complete prototype environmental features signature model for simulation of advanced sensing systems.</li> <li>- Validate prototype materials for low-temperature repairs to concrete and provide design guidance for use of low quality material in pavements for expedient use in theater of operations supporting military infrastructure repair, operation, and design cost reduction programs.</li> </ul> </li> <li>• 884 - Define effects of snow and frozen ground on mine detection mechanisms and upgrade ability to characterize and forecast streamflow resulting from snowmelt and its impact on bridging and mobility.</li> </ul> <p>Total 5425</p> |                   |                     |                     |  |                     |                     |                           |                        |                     |            |
| Project AT42  |                   |                     | Page 12 of 15 Pages |  |                     |                     | Exhibit R-2 (PE 0602784A) |                        |                     |            |

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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602784A Military Engineering Technology</b> | <b>PROJECT</b><br><b>AT42</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3647 - Generate dynamic integrated IR/MMW winter backgrounds for synthetic scene simulation .</li> <li style="padding-left: 20px;">- Develop winter effects conditions models for use in Army combat simulations.</li> <li style="padding-left: 20px;">- Develop methods for expedient stabilization of thawing soils for theater of operations main supply route development and maintenance.</li> </ul> <p>Total 3647</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3567 - Validate models to spatially distribute winter terrain effects for Army simulations .</li> <li style="padding-left: 20px;">- Integrate single and dual mode IR/MMW sensor-environment models in Army virtual proving ground software.</li> <li style="padding-left: 20px;">- Begin to develop techniques for expedient enhancement, maintenance, and operation of airfields in winter conditions.</li> </ul> <p>Total 3567</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4168</td> <td style="text-align: center;">4541</td> <td style="text-align: center;">3632</td> <td style="text-align: center;">4548</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4292</td> <td style="text-align: center;">5425</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-106</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4186</td> <td style="text-align: center;">5425</td> <td style="text-align: center;">3647</td> <td style="text-align: center;">3567</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY1997- Funding increased by Congress (+884) to define effects of snow and frozen ground on mine detection and to upgrade ability to characterize and forecast streamflow resulting from snowmelt and its impact on bridging and mobility.</p> <p style="padding-left: 40px;">FY1999- Funding reprogrammed (-981) to higher priority requirements.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4168 | 4541 | 3632 | 4548 | Appropriated Value | 4292 | 5425 |  |  | Adjustments to Appropriated Value | -106 |  |  |  | FY 1998 Pres Bud Request | 4186 | 5425 | 3647 | 3567 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 4168  | 4541                          | 3632           | 4548           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 4292  | 5425                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -106  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 4186  | 5425                          | 3647           | 3567           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AT42  | Page 13 of 15 Pages   | Exhibit R-2 (PE 0602784A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> |                     |                           |                     | PROJECT<br><b>AT45</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| AT45 Energy Technology Applied to Military Facilities   | 1966              | 2372                | 2338                | 2564   | 2754                | 2551                      | 2510                | 2570                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description Justification:</u></b> Energy is essential for the modern Army to meet its mission. The research conducted in this project provides the technology for providing energy efficient facilities, adapting new energy source technologies to military facilities, applying cost effective renewable energy technologies for Army uses, and improving the efficiency of Army central energy plants. Research focuses on leveraging industry technology investments and integrating a broad range of advanced technologies into a comprehensive system to meet the specialized needs of the Army utilities systems. Activities include modeling and simulation of thermal loops and electrical systems, developing new analytic techniques, and incorporating new system designs and hardware in conjunction with industry. Research products/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 20% by 2001 from the 1985 baseline. The work is managed by the Construction Engineering Research Laboratories, Champaign, Illinois.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1966 - Developed computer assisted training modules for achieving energy efficient facilities.</li> <li style="padding-left: 20px;">- Applied energy efficient commercial/off-the-shelf (COTS) lighting technologies to Army facilities.</li> <li style="padding-left: 20px;">- Developed refined cost-benefit model for prioritization of energy conservation alternatives applicable for DoD facilities.</li> <li style="padding-left: 20px;">- Developed energy usage-workforce productivity relationship model.</li> </ul> <p>Total 1966</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2372 - Provide Department of Energy a repository of designs for standard military facilities.</li> <li style="padding-left: 20px;">- Develop methods for adopting fuel cell technology in Army energy plants.</li> <li style="padding-left: 20px;">- Develop advanced digital control for heating, ventilation, air-conditioning (HVAC) to improve accuracy, reduce energy costs, and improve indoor air quality.</li> <li style="padding-left: 20px;">- Complete application guidelines for emerging natural gas based cooling systems.</li> </ul> <p>Total 2372</p> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| Project AT45  |                   |                     | Page 14 of 15 Pages |  |                     | Exhibit R-2 (PE 0602784A) |                     |                              |                     |            |

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|--|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602784A Military Engineering Technology</b> | PROJECT<br><b>AT45</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2338 - Develop methodology to determine the optimal mix of centralized and decentralized energy supply options for Army facilities.</li> <li style="padding-left: 20px;">- Complete application guidelines for phosphoric acid fuel cell technology.</li> <li style="padding-left: 20px;">- Develop methodology for optimizing natural gas distribution systems for Army facilities.</li> <li style="padding-left: 20px;">- Initiate development of virtual reality based design tools for building envelope, electrical and mechanical systems.</li> </ul> <p>Total 2338</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2564 - Complete self-tuning adaptive control algorithms for utility plant automation.</li> <li style="padding-left: 20px;">- Develop methodology for optimizing electrical distribution and supply to Army facilities.</li> <li style="padding-left: 20px;">- Develop concurrent engineering principles for community design concepts between electrical and mechanical building systems.</li> </ul> <p>Total 2564</p> <p><b><u>B. Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2048</td> <td style="text-align: center;">2422</td> <td style="text-align: center;">2324</td> <td style="text-align: center;">2546</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2105</td> <td style="text-align: center;">2372</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-139</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">1966</td> <td style="text-align: center;">2372</td> <td style="text-align: center;">2338</td> <td style="text-align: center;">2564</td> </tr> </tbody> </table> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2048 | 2422 | 2324 | 2546 | Appropriated Value | 2105 | 2372 |  |  | Adjustments to Appropriated Value | -139 |  |  |  | FY 1998 Pres Bud Request | 1966 | 2372 | 2338 | 2564 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 2048   | 2422                         | 2324           | 2546           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 2105   | 2372                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -139   |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 1966   | 2372                         | 2338           | 2564           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project AT45   | Page 15 of 15 Pages  | Exhibit R-2 (PE 0602784A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0602785A Manpower/Personnel/Training<br/>Technology</b> |                     |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost   | 7254              | 9329                | 9014                | 9019   | 9016                | 9013                | 9010                | 9007                         | Continuing          | Continuing |
| A790 Personnel Systems and Performance<br>Technology  | 2554              | 3042                | 9014                | 9019   | 9016                | 9013                | 9010                | 9007                         | Continuing          | Continuing |
| A791 Education and Training Technology  | 4700              | 6287                | 0                   | 0  | 0                   | 0                   | 0                   | 0                            | 0                   | 10987      |
| <p><b><u>Mission Description and Budget Item Justification :</u></b> The objective of this program is to maximize soldier and unit performance based on research in leader development, selection and classification, and optimal training strategies. Research programs include training strategies for the digitized battlefield, training strategies in simulated environments, optimum designs of simulators and training devices to achieve maximum learning at minimum cost, and modernization of the selection and classification system to maintain warfighting capabilities in a downsized Army. Research in the PE is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. The projects include non-system specific development efforts pointed toward specific military needs and are therefore appropriate to Budget Activity 2. The majority of the research conducted in the PE transitions to Manpower, Personnel, and Training Advanced Technology (PE 0603007A) development. This PE is managed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). As a result of HQDA Redesign, ARI's research program has undergone major restructuring.</p> |                   |                     |                     |  |                     |                     |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                          |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                          | PE NUMBER AND TITLE<br><b>0602785A Manpower/Personnel/Training<br/>Technology</b> |                     |                     |                           | PROJECT<br><b>A790</b>       |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A790 Personnel Systems and Performance<br>Technology  | 2554              | 3042                | 9014                     | 9019  | 9016                | 9013                | 9010                      | 9007                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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, and the impact of stability operations on personnel issues (e.g., career commitment). Research under this project supports the manpower and personnel Defense technology area. Beginning in FY1998, this project is restructured to include training research.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2554 - Validated new measures of performance-related aptitude, leadership, and stress tolerance.</li> <li style="padding-left: 20px;">- Modeled the development of commander knowledge and skills.</li> <li style="padding-left: 20px;">- Developed methods for measuring the leadership knowledge acquired through operational experience.</li> <li style="padding-left: 20px;">- Identified economic, family support and career commitment factors that influence a reservist's decision to volunteer for stability operations.</li> </ul> <p>Total 2554</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3042 - Develop models of impact of peacekeeping operations on career development and commitment.</li> <li style="padding-left: 20px;">- Complete development of new measures of aptitude related to enlisted leader performance requirements.</li> <li style="padding-left: 20px;">- Design techniques for developing and training decision making skills.</li> <li style="padding-left: 20px;">- Develop new measures for assessing leadership potential in officer candidates.</li> <li style="padding-left: 20px;">- Identify preliminary set of leader attributes needed in 2010 and beyond.</li> </ul> <p>Total 3042</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9014 - Develop prototype training methods and performance assessment instruments in support of the digitized battlefield.</li> <li style="padding-left: 20px;">- Determine simulator fidelity requirements in support of Aviation Combined Arms Tactical Trainer.</li> <li style="padding-left: 20px;">- Demonstrate training methods in virtual environments for fire teams.</li> <li style="padding-left: 20px;">- Generate list of representative, Army-wide, 21st Century Non-Commissioned Officer performance requirements.</li> <li style="padding-left: 20px;">- Develop structural models of the impact of stability operations on personnel issues.</li> </ul> |                   |                     |                          |   |                     |                     |                           |                              |                     |            |
| Project A790  |                   |                     | <i>Page 2 of 5 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0602785A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                           |                |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602785A Manpower/Personnel/Training<br/>Technology</b> | <b>PROJECT</b><br><b>A790</b> |                           |                |
| Total            9014   |  |                               |                           |                |
| <b>FY 1999 Planned Program:</b> <ul style="list-style-type: none"> <li>•            9019   - Evaluate prototype training methods and performance assessment instruments in support of mounted and light infantry forces on the digitized battlefield.</li> <li>                     - Develop training strategies for reconfigurable rotary-wing simulators.</li> <li>                     - Demonstrate speech recognition in foreign language tutor.</li> <li>                     - Develop attribute list needed to meet NCO performance requirements identified for the 21st Century.</li> <li>                     - Develop training strategies for the dismounted soldier in simulated environments.</li> </ul> Total            9019 |  |                               |                           |                |
| <b><u>B. Project Change Summary</u></b>   |  |                               |                           |                |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget  | 2582   | 3107                          | 3224                      | 3704           |
| Appropriated Value  | 2653   | 3042                          |                           |                |
| Adjustments to Appropriated Value   | -99  |                               |                           |                |
| FY 1998 Pres Bud Request  | 2554   | 3042                          | 9014                      | 9019           |
| Change Summary Explanation: Funding: This project was restructured to include training research (FY1998, +5790; FY1999, +5315) starting in FY 1998..  |  |                               |                           |                |
|   |  |                               |                           |                |
| Project A790  | Page 3 of 5 Pages  |                               | Exhibit R-2 (PE 0602785A) |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602785A Manpower/Personnel/Training<br/>Technology</b> |                     |                     |                           |                              | PROJECT<br><b>A791</b> |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| A791 Education and Training Technology  | 4700              | 6287                | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                      | 10987      |
| <p><b>A. <u>Mission Description and Justification:</u></b> The objectives of this project are to provide the behavioral technologies 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, with focus on the digitized battlefield of the future. It will develop training methods to improve night operations, individual training strategies exploiting "virtual reality" technology for training and rehearsal of warfighting missions and stability operations, and determination of requirements for cost-effective simulator training on selected aviation tasks. Research under this project directly supports the training systems Defense technology area. Beginning in FY1998, this research is restructured to project A790.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4700 - Designed and tested methodology for developing brigade and multi-service training and assessment programs.             <ul style="list-style-type: none"> <li>- Determined display resolution requirements for flight simulator-based task training.</li> <li>- Extracted training lessons learned from Mounted Battlespace Battle Lab's "Focused Dispatch" Advanced Warfighting Experiment.</li> <li>- Developed experimental training techniques to improve thermal target acquisition skills.</li> <li>- Demonstrated and assessed capability to conduct team training in virtual reality environments.</li> </ul> </li> </ul> <p>Total 4700</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6287 - Determine simulator fidelity required for command and control in networked aviation training systems.             <ul style="list-style-type: none"> <li>- Design training and performance evaluation techniques to support Force XXI digital capabilities.</li> <li>- Develop prototype simulation-based immersive training techniques for dismounted combatants.</li> <li>- Complete development of prototype training techniques to improve combat vehicle identification utilizing 2nd generation FLIR (forward looking infrared) sensors.</li> <li>- Demonstrate technologies to improve the effectiveness and efficiency of Individual Ready Reserve (IRR) at mobilization.</li> </ul> </li> </ul> <p>Total 6287</p> <p><b>FY 1998 Planned Program:</b> Program restructured to project A790.</p> |                   |                     |                     |   |                     |                     |                           |                              |                        |            |
| Project A791  |                   |                     | Page 4 of 5 Pages   |   |                     |                     | Exhibit R-2 (PE 0602785A) |                              |                        |            |

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| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>   | <b>PE NUMBER AND TITLE</b><br><b>0602785A Manpower/Personnel/Training<br/>Technology</b> | <b>PROJECT</b><br><b>A791</b> |                           |                |
| <b>FY 1999 Planned Program:</b> Program restructured to project A790.   |  |                               |                           |                |
| <b><u>B. Project Change Summary</u></b>   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY1997 President's Budget   | 4716   | 6421                          | 7450                      | 8194           |
| Appropriated Value  | 4847   | 6287                          |                           |                |
| Adjustments to Appropriated Value   | -147   |                               |                           |                |
| FY 1998 Pres Bud Request  | 4700   | 6287                          | 0                         | 0              |
| Change Summary Explanation: Funding: As a result of ARI restructuring, training research is reported in Project A790 beginning in FY1998. |  |                               |                           |                |
|   |  |                               |                           |                |
| Project A791  | Page 5 of 5 Pages  |                               | Exhibit R-2 (PE 0602785A) |                |

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| BUDGET ACTIVITY<br><b>2 - Applied Research</b> | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> |
|--|---|

| COST (In Thousands)                        | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|--|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| Total Program Element (PE) Cost            | 26995          | 21319            | 17196            | 18565            | 18478            | 18023            | 18468            | 18876            | Continuing       | Continuing |
| AH20 Mobility Equipment Technology         | 6980           | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 6980       |
| AC60 TRACTOR ZINC                          | 0              | 3208             | 2034             | 2076             | 2156             | 957              | 974              | 992              | Continuing       | Continuing |
| AH98 Clothing and Equipment Technology     | 12144          | 9245             | 9102             | 9971             | 9713             | 10293            | 10582            | 10824            | Continuing       | Continuing |
| AH99 Joint Services Food/System Technology | 5198           | 4299             | 4368             | 4615             | 4714             | 4813             | 4913             | 5020             | Continuing       | Continuing |
| DJ10 Combat Rations Quality Enhancement    | 1197           | 2937             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 4134       |
| D283 Airdrop Advanced Technology           | 1476           | 1630             | 1692             | 1903             | 1895             | 1960             | 1999             | 2040             | Continuing       | Continuing |

**Mission Description and Budget Item Justification:** This program element provides technology for the individual soldier and airdrop technology. Unusual demands will be placed on the soldier and soldier support systems by future hardware. In order to achieve required individual performance, mobility, and effectiveness, there must be associated technology developments evolving in soldier support equipment, supplies, and systems to make them smaller, lighter, more reliable and durable, more survivable, less manpower intensive, affordable, and more mobile. Technology efforts on clothing and equipment and cutting edge technologies for high pressure airbeam supported shelters provide enhanced warfighter protection from both combat threats and from the natural field environment. The Joint Services Food/System Technology program supports all Military Services, the Special Operations Command, and the Defense Logistics Agency with research and development of high impact/high payoff technologies for military food products, packaging, and combat food service equipment. The Combat Ration Quality Enhancement project establishes 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 air dropping larger combat and logistics loads while improving delivery accuracy, minimizing vulnerability of aircraft and reducing life cycle costs. This is a critical capability for rapid force projection, particularly into hostile environments. The focus of investigation in mobility equipment technology included landmine detection and neutralization, counter-surveillance, 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 operational rations and field food service equipment, 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 by the U.S. Army Natick Research, Development and Engineering Center, Natick, MA. The Night Vision and Electronic Sensors Directorate of the Communications-Electronics Command managed the Mobility Equipment Technology project which ended in FY 1996. 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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| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> |                     |                           |                     | PROJECT<br><b>AH20</b>       |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| AH20 Mobility Equipment Technology  | 6980              | 0                   | 0                   | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 6980       |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| <p><b>A. Mission Description and Justification:</b> This exploratory development program addressed the need for advanced combat support and combat service support equipment and material. The project was directed toward providing the technology to solve deficiencies in the Army mission areas of engineer-mine warfare and combat service support. It included efforts in low-cost signature reduction, counter-surveillance, deception, survivability, countermine, mobile electric power, and environmental control. Beginning in FY 1997 this work was restructured to PE 0602712A (Countermining Applied Research)/ Project AH24 and PE 0602705A (Electronics and Electronic Devices)/ Project AH11.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 6107 - Developed multisensor deception materials and collected field data to validate representation of low observables in target acquisition/wargame simulations.<br/>- Evaluated imaging infrared (IR) and frequency agile radar for mine detection on mobile combat vehicle testbed; developed preliminary design of explosive mine neutralization system.<br/>- Conducted castform simulations to develop scenarios for countermining demonstration; selected software architecture and insertion points for integrating mine/countermining functions in distributed interactive simulation (DIS) environment.</li> <li>• 873 - Demonstrated fuel cell power sources at 50W and 150W levels; tested and evaluated fuel cells.<br/>- Initiated fabrication and testing of portable, JP-8 fuel burning 1.5kW engine driven generator set comprised of novel permanent and advanced fuel injection hardware.</li> </ul> <p>Total 6980</p> <p><b>FY 1997 Planned Program:</b> Project tasks restructured to PE 0602712A/AH24 and PE 0602705A/AH11.</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border: none;"> <thead> <tr> <th style="width: 50%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">7004</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">7203</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-223</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">6980</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 7004 | 0 | 0 | 0 | Appropriated Value | 7203 |  |  |  | Adjustments to Appropriated Value | -223 |  |  |  | FY 1998 Pres Bud Request | 6980 | 0 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1997 President's Budget  | 7004              | 0                   | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Appropriated Value  | 7203              |                     |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Adjustments to Appropriated Value   | -223              |                     |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1998 Pres Bud Request  | 6980              | 0                   | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Project AH20  |                   | Page 2 of 14 Pages  |                     |   |                     | Exhibit R-2 (PE 0602786A) |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |                |                  |                    |   |                  |                  |                           | DATE<br><b>February 1997</b> |                  |            |
|--|----------------|------------------|--------------------|---|------------------|------------------|---------------------------|------------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                |                  |                    | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> |                  |                  |                           | PROJECT<br><b>AH98</b>       |                  |            |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate             | Cost to Complete | Total Cost |
| AH98 Clothing and Equipment Technology   | 12144          | 9245             | 9102               | 9971  | 9713             | 10293            | 10582                     | 10824                        | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> This exploratory development effort improves soldier survivability and performance through significantly improved materials and new technology applications for combat clothing and personal equipment. Areas of emphasis include material development to improve: ballistic, flame, and directed energy protection; enhanced 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&amp;D) alternatives. In FY 1997, technology on selectively permeable membranes for chemical protection was restructured to DoD PE 0602384BP as part of the consolidated DoD Chemical/Biological Defense program.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 6601 - Investigated the optimization of parameters of components for multiple ballistic threat protection (fragments and small arms) to reduce weight and bulk while increasing performance of body armor for soldiers and police; determined viability of flexible ballistic protective materials system for small arms protection through analytical and experimental analysis. <ul style="list-style-type: none"> <li>- Developed first generation silk protein-based polymers for genetically engineered ballistic protective fibers.</li> <li>- Optimized and scaled-up selected thermal signature reducing materials for personal camouflage.</li> <li>- Inserted combined dye technology (for 532 nm) and broadband (694 through 1064 nm) dielectric technology into polycarbonate laser protective eyewear.</li> </ul> </li> <li>• 5543 - Integrated optimized, selectively permeable membranes and permeable fabrics into lightweight (20% less than standard overgarment), moisture vapor permeable textile systems for chemical protection for Joint Service Lightweight Integrated Suit Technology (JSLIST) P<sup>3</sup>I and Land Warrior. <ul style="list-style-type: none"> <li>- Investigated feasibility of incorporation of new carbonaceous fiber into existing nylon-cotton protective uniform fabrics to impart durable flame resistance; demonstrated electrically heated handwear with an optimized design of the controller/liner; defined the protective technology requirements for flame and thermal battlefield threats.</li> <li>- Completed parametric analysis of proposed Force XXI Land Warrior component and module designs to support optimization of soldier performance and survival; provided modeling, simulation, and analysis support to clothing and textile development to quantify and maximize the viability/capability of proposed systems; provided critical soldier performance data for Integrated Unit Simulation System (IUSS) model; provided a first generation individual soldier simulation to support virtual simulation for Force XXI Land Warrior.</li> <li>- Evaluated optimal designs for biomechanically efficient prototype footwear and developed protocol for military field testing; applied motion analysis techniques to assess soldier-clothing/equipment interface; validated 3D whole-body laser scanning methodology; developed prototype lightweight, modular microclimate cooling system.</li> <li>- Fabricated and demonstrated full scale Large Area Night Maintenance Shelter using airbeam technology for the structural members.</li> </ul> </li> </ul> <p>Total 12144</p> <p><b>FY 1997 Planned Program:</b></p> |                |                  |                    |   |                  |                  |                           |                              |                  |            |
| Project AH98   |                |                  | Page 3 of 14 Pages |   |                  |                  | Exhibit R-2 (PE 0602786A) |                              |                  |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b> |
|--|---|------------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> | PROJECT<br><b>AH98</b>       |
| <ul style="list-style-type: none"> <li>• 4865 - Conduct integration of optimized small arms protective technologies and fragmentation protective technologies leading to a 20-30% total weight reduction and evaluate against multiple ballistic threats.                             <ul style="list-style-type: none"> <li>- Evaluate ballistic protective properties of high-performance genetically engineered silk.</li> <li>- Complete scale-up of additional thermal signature reducing materials and incorporate best candidates into personal camouflage and combat clothing.</li> <li>- Synthesize and characterize improved nonlinear optical materials for incorporation into design configurations that provide maximum attenuation of agile laser energies; provide tunable laser eye protection using band blocking strategies.</li> </ul> </li> <li>• 4380 - Establish military flame/thermal hazards and battlefield assessment for ground soldiers; develop appropriate protective strategies; integrate durable static dissipation characteristics in the environmental protective fabrics.                             <ul style="list-style-type: none"> <li>- Provide modeling, simulation and analysis to support the design of the Force XXI Land Warrior early user test; develop initial suite of modeling, simulation and analytic tools around integrated ballistics, heat stress and ground mobility to support systems performance and survivability assessments of emerging Land Warrior systems.</li> <li>- Conduct field investigation of soldier performance in combat-related activities to validate lab findings on the soldier-clothing/equipment interface; perform lab-based biomechanical evaluations on prototype footwear and conduct small scale military field test to obtain user feedback and verification of evaluations on footwear characteristics; demonstrate and evaluate a lightweight modular vapor compression microclimate cooling system; complete proof of concept study for a lightweight non-electric complex compound microclimate cooling system.</li> </ul> </li> </ul> |   |                              |
| Total  | 9245  |                              |
| <b>FY 1998 Planned Program:</b>  |   |                              |
| <ul style="list-style-type: none"> <li>• 5064 -Demonstrate advanced material system for protection against combined fragmentation and small arms threats (known ball threats up to/including 0.30 caliber) at a reduced areal density (weight) compared to current small arms protection, without significantly increasing other penalties.                             <ul style="list-style-type: none"> <li>- Increase expression levels of first generation silk protein, for genetically engineered ballistic SP-2LS materials, to 100mg/liter; demonstrate flame retardant fabric coating based on enzymatic polymer synthesis.</li> <li>- Develop a site specific/rapid fabrication camouflage capability and demonstrate several prototype combat uniforms for special operations.</li> <li>- Incorporate the best performing nonlinear materials for laser/ballistic eye protection into thin films or graded-density substrates and evaluate the optical attenuation they provide; continue nonlinear material characterization and synthesis efforts.</li> </ul> </li> <li>• 4038 - Optimize flame retardant nylon fabric; produce yardage and prototype garments; develop flame/thermal model to predict the impact of flame resistant material system on the performance of the soldier in varying scenarios; establish baseline performance criteria and test methodologies for the wear life of the combat uniforms.                             <ul style="list-style-type: none"> <li>- Provide modeling, simulation and analytic tools to facilitate the cost and operational effectiveness analysis of Land Warrior and risk reduction and insertion of components into the Force XXI Land Warrior program.</li> <li>- Finalize whole body scan protocols compatible with ANSUR 2-D database standards; complete modular head and face models for Integrated Headgear; fabricate prototype boots for field testing; demonstrate and evaluate a prototype lightweight non-electric microclimate cooling system.</li> </ul> </li> </ul>   |   |                              |
| Total  | 9102  |                              |
| <b>FY 1999 Planned Program:</b>  |   |                              |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |      | DATE<br><b>February 1997</b>  |                |                        |                |
|--|------|---|----------------|------------------------|----------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 |      | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b>   |                | PROJECT<br><b>AH98</b> |                |
| •  | 5644 | - Transition improved small arms protective material system to advanced development and/or as technology insertions to modify existing individual protective items; conduct optimization of new materials for next generation multiple ballistic threat protection (increased small arms, advanced fragmentation, and improved blast protection).<br>- Develop silk-based fabric for ballistic protective applications.<br>- Demonstrate combat uniform systems that further reduce the soldier's thermal signature from background levels and exhibit improved textile performance.<br>- Using the best available materials and implementation strategies, assemble a breadboard tunable protective device for laser/ballistic eye protection; continue investigations into material characteristics and nonlinear optical effects enhancement techniques. |                |                        |                |
| •  | 4327 | - Demonstrate combat uniform fabrics with durable multi-functional protection (e.g., flame retardant, water repellent, chemical protective, and camouflage printable).<br>- Complete analytic assessment of Force XXI Land Warrior early user test.<br>- Demonstrate custom clothing patterns from 3-D scan data; demonstrate a 10-15 percent reduction in the probability of occurrence of stress related, lower extremity disorders among ground troops wearing the new combat boots; complete proof of concept study for an individual body heating system.  |                |                        |                |
| Total  | 9971 |   |                |                        |                |
| <b>B. Project Change Summary</b>                               |      | <u>FY 1996</u>  | <u>FY 1997</u> | <u>FY 1998</u>         | <u>FY 1999</u> |
| FY 1997 President's Budget                                     |      | 12273   | 9464           | 9920                   | 10635          |
| Appropriated Value   |      | 12615   | 9245           |                        |                |
| Adjustments to Appropriated Value                              |      | -471  |                |                        |                |
| FY 1998 Pres Bud Request                                       |      | 12144   | 9245           | 9102                   | 9971           |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |  |                    |                  |   |                  |                           |                  | DATE<br><b>February 1997</b> |                  |                  |            |
|---|--|--------------------|------------------|---|------------------|---------------------------|------------------|------------------------------|------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |  |                    |                  | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> |                  |                           |                  | PROJECT<br><b>AH99</b>       |                  |                  |            |
| COST (In Thousands)   |  | FY 1996 Actual     | FY 1997 Estimate | FY 1998 Estimate  | FY 1999 Estimate | FY 2000 Estimate          | FY 2001 Estimate | FY 2002 Estimate             | FY 2003 Estimate | Cost to Complete | Total Cost |
| AH99 Joint Services Food/System Technology  |  | 5198               | 4299             | 4368  | 4615             | 4714                      | 4813             | 4913                         | 5020             | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> This DoD program for which the Army has Executive Agency responsibility addresses high impact, high payoff food and food system technologies to support all military Services, Special Operations Command, and the Defense Logistics Agency. Thrust areas include the 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1171 - Evaluated the use of post-coatings for primary and secondary food packaging materials to determine feasibility of increasing use of Commercial-Off-The-Shelf (COTS) items in operational rations; conducted accelerated and long-term storage, sensory and microbiology testing on food products packaged in oxygen absorbent packaging.<br/>- Developed and tested new preservation technologies for mobility enhancing ration components; conducted field evaluation on performance/utility and acceptability of new nonmetallic primary containers for use in Unitized Group Ration; continued to investigate technologies (e.g., high dose sterilization, pasteurization) which allow the safe incorporation of chilled items (i.e., fresh poultry, fruit, luncheon meats) into operational rations; completed analytical database to assess operational rations for performance-enhancing nutrients.</li> <li>• 1502 - Completed experimental development of a Nonflammable Ration Heater that costs less and is safer to use than present heaters and transitioned to ration improvement program for engineering development and fielding; completed experimental phase of catalytic reforming of diesel fuel by optimizing process parameters for maximum gas phase hydrocarbon yield; designed and fabricated experimental absorption type heat driven refrigerator and transitioned to technology demonstration; developed and tested low output (1000 BTU/hr) diesel burner for absorption refrigeration system; investigated new food service equipment technologies (e.g., multifunctional, energy efficient, modular equipment) to reduce cost and improve reliability of present and future shipboard galleys; evaluated source reduction equipment to reduce waste backhaul from field kitchens.</li> <li>• 2525 - Completed selection of constituents and identified acceptable formulation for ration components which ensure enhanced performance under different combat situations; conducted field testing of components to quantify warfighter performance enhancement under varied tactical conditions.<br/>- Identified and optimized complex carbohydrate components which meet energy requirements during periods of high performance; conducted limited, accelerated technical tests and user studies to evaluate ability to modulate metabolic release over time; identified key process parameters for optimizing innovative thermal processing of rations (i.e., ohmic heating and microwave sterilization) to support the incorporation of "fresh-like" components into operational rations; evaluated emerging microbial issues for safety assessment of temperature abused food to maintain safe/wholesome food supply.</li> </ul> <p><b>FY 1996 Accomplishments: (continued)</b></p> |  |                    |                  |   |                  |                           |                  |                              |                  |                  |            |
| Project AH99  |  | Page 6 of 14 Pages |                  |   |                  | Exhibit R-2 (PE 0602786A) |                  |                              |                  |                  |            |

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|--|---|--|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> | PROJECT<br><b>AH99</b>   |
| Total  | 5198  | - Completed laboratory and storage studies for improved high heat, shelf stable ration; transitioned methodology for assessing ration quality of stored rations; completed sensory acceptability studies of novel processed marine products; continued analysis of preservation technologies for destruction of microorganisms in marine products; completed field trials of microbial and chemical test kits to assess sanitation in food processing, assuring ration quality and reducing risk of food borne illness and transitioned to Veterinary Command (VETCOM).  |
| <b>FY 1997 Planned Program:</b>                                |   |  |
| •  | 1625  | - Conduct performance tests for continued ration quality on post coated primary and/or secondary food containers of commercially available food items which will improve acceptability; design prototype laminated structure with embedded glass coating for polymeric tray as alternative source to expand production base; conduct storage and sensory tests of ration components packaged in oxygen absorbent materials; identify emerging technologies for interactive packaging and fabricate prototype; continue to investigate irradiation sterilization and pasteurization technologies to improve ration quality and enhance logistics.<br>-Complete optimization and conduct field evaluation of consumer acceptable rations with effective second generation components demonstrating performance enhancement to identify potential components for technology insertion into fielded rations; validate feasibility of intermediate moisture mobility enhancing ration components. |
| •  | 1488  | - Select/incorporate neurotransmitter precursors in ration components or as supplements for improving performance.<br>- Exploit capability to non-invasively measure physiological indices when evaluating nutrients for performance enhancements; continue to identify process parameters for optimizing innovative thermal processing of rations (i.e., ohmic heating) and pursue Food and Drug Administration approval of cutting-edge mechanism to determine sterility; identify/exploit novel hurdle systems to support the incorporation of "fresh-like" and intermediate moisture food components into operational rations.   |
| •  | 1165  | - Design and fabricate experimental diesel to gas reformer that can provide a natural-gas-like fuel for commercial gas cooking appliances and transition to technology demonstration; design and fabricate experimental adsorption type thermal fluid driven refrigerator and transition to technology demonstration; integrate low output diesel burner in an absorption refrigeration system and conduct technical feasibility tests; test and evaluate feasibility and functionality of future shipboard galley concept incorporating new food service equipment technologies.  |
| •  | 21  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |
| Total  | 4299  |  |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |   | DATE<br><b>February 1997</b> |
|--|---|------------------------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b>   | PROJECT<br><b>AH99</b>       |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| • 1797   | - Investigate cell culture support and monitoring system; determine effects of food components on sleep/wake cycles to enhance combat effectiveness; model the effects of nutrition and hydration on soldier performance.<br>- Evaluate/develop novel hurdle preservation technologies (water activity reducing components, non-thermal processes), identify suitable recognition compounds and biosensor systems; continue to investigate high dose sterilization to improve quality of military ration components and quantify logistics savings; investigate innovative non-thermal processes for moisture extraction in ration components.  |                              |
| • 1336   | - Incorporate interactive packaging technologies (e.g., oxygen and moisture absorbing) into ration component systems to reduce or eliminate combat ration degradation during storage; fabricate/test high barrier, glass-coated, retortable polymeric tray with easy-open lid for multi-serve, shelf-stable food containers; finalize barrier post coating methodology/application techniques for military use of COTS products and transition to Fielded Group Ration Improvement Program (FGRIP).<br>- Complete component development of individual warfighter mobility enhancing ration components.  |                              |
| • 1235   | - Initiate experimental development programs for expeditionary field feeding delivery systems, diesel fired flash bake oven, and individual beverage heater; integrate membrane technology with diesel to gas reformer to provide hydrogen for fuel cell operation.   |                              |
| Total  | 4368  |                              |
| <b>FY 1999 Planned Program:</b>                                |   |                              |
| • 1833   | - Continue to investigate/evaluate evolving preservation technologies for ration component; exploit novel ingredients/processes for stabilizing structure and for controlling microbial growth to produce shelf stable, non-retorted components; optimize processing and packaging parameters for shelf-stable vegetables and fruit.<br>- Continue to determine effects of food components on sleep/wake cycles and downselect the effective nutrients for transitioning to Fielded Individual Ration Improvement Program (FIRIP).<br>- Select/incorporate neurotransmitter precursors in ration components/supplements for anti-stress benefits.<br>- Exploit irradiation sterilization to facilitate the incorporation of "fresh-like" components in military rations.<br>- Evaluate and optimize nutraceutical products for ration supplementation to optimize combat effectiveness.   |                              |
| • 1694   | - Optimize processing variables of non-thermal and preconcentration processes on a range of selected ration components to reduce degradative effects, cube, and weight; explore synergistic combinations of new thermal (ohmic and microwave) and non thermal (high pressure and irradiation) to reduce overall processing and produce stable, "just prepared" rations; develop and optimize biosensor probes for quality determination of combat rations by ration inspectors, investigate emerging packaging, ration, and equipment technologies to improve functionality and reduce cost; develop a remote ration quality monitoring system to ensure that the least fresh are shipped first.<br>- Initiate exploratory development program for bioengineering of high energy ration components, incorporation of complex nutri-fuels into rations for improved performance and stress reduction, and protein enhancement of ration components for improved nutritional quality. |                              |
| <b>FY 1999 Planned Program: (continued)</b>                    |   |                              |
| Project AH99   | Page 8 of 14 Pages  | Exhibit R-2 (PE 0602786A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |                               |                |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602786A Logistics Technology</b> |                              | <b>PROJECT</b><br><b>AH99</b> |                |
| <ul style="list-style-type: none"> <li>• 1088 - Conduct field evaluations of expeditionary field feeding delivery system for force projection; design and test experimental diesel fired flash bake oven; complete field tests of individual beverage heater and transition to ration improvement program for fielding; produce hydrogen from the diesel to gas reformer and operate a fuel cell.</li> </ul> <p>Total 4615</p> |  |                              |                               |                |
| <b>B. <u>Project Change Summary</u></b>  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u>                | <u>FY 1999</u> |
| FY 1997 President's Budget   | 5263   | 4402                         | 5444                          | 5810           |
| Appropriated Value   | 5409   | 4299                         |                               |                |
| Adjustments to Appropriated Value  | -211   |                              |                               |                |
| FY 1998 Pres Bud Request   | 5198   | 4299                         | 4368                          | 4615           |
| <p>Change Summary Explanation: Funding: FY 1998 - Funding reprogrammed (-1076) for higher priority requirements.<br/> FY 1999 - Funding reprogrammed (-1195) for higher priority requirements.</p>   |  |                              |                               |                |
|  |  |                              |                               |                |
| Project AH99   | Page 9 of 14 Pages   | Exhibit R-2 (PE 0602786A)    |                               |                |

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> |                     |                     |                           | PROJECT<br><b>DJ10</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| DJ10 Combat Rations Quality Enhancement  | 1197              | 2937                | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                   | 4134       |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project was initiated in FY1992 at the request of Congress to establish a 5 year project to develop technologies for quantifying food quality in combat rations and other emergency feeding situations to enhance consumer acceptance. The project continued in FY 1997 through additional Congressional interest funds. Parameters affecting food quality, including interrelationships among raw materials, processing, packaging, and storage, are determined and analytical techniques for quantification are developed. Innovative processing methods (ohmic heating and combination preservation processes) are investigated. Optimal raw material processing techniques and packaging systems are selected to minimize deteriorative changes in foods and maximize the deliverable quality of subsistence to the user community. The project includes the use of novel electric field and high pressure technologies to pasteurize acidic foods; the efficacy and practicality of non-thermal pasteurization is explored.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1197 - Completed identification and characterization of factors affecting ration quality; identified test methods and models which quantify the quality of combat rations.</li> </ul> <p>Total 1197</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2865 - Establish good manufacturing practice demonstration sites to facilitate regulatory approval of high pressure and pulsed electric field processing.             <ul style="list-style-type: none"> <li>- Conduct efficiency and efficacy tests of batch vs. semi-continuous high pressure processes.</li> <li>- Validate test methods and models which quantify the quality of combat rations.</li> </ul> </li> <li>• 72 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2937</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project DJ10   |                   |                     | Page 10 of 14 Pages |   |                     |                     | Exhibit R-2 (PE 0602786A) |                              |                     |            |

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|--|--|---------------------------|----------------|-------------------------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  |                           |                | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>2 - Applied Research</b>  | <b>PE NUMBER AND TITLE</b><br><b>0602786A Logistics Technology</b> |                           |                | <b>PROJECT</b><br><b>DJ10</b> |
| <b><u>B. Project Change Summary</u></b>  | <u>FY 1996</u>   | <u>FY 1997</u>            | <u>FY 1998</u> | <u>FY 1999</u>                |
| FY 1997 President's Budget   | 1228   | 0                         | 0              | 0                             |
| Appropriated Value   | 1263   | 2937                      |                |                               |
| Adjustments to Appropriated Value  | -66  |                           |                |                               |
| FY 1998 Pres Bud Request   | 1197   | 2937                      | 0              | 0                             |
| <br>Change Summary Explanation: Funding: FY 1997 - Funding increased by Congress (+2937) to develop technologies for quantifying food quality in combat rations. |  |                           |                |                               |
|  |  |                           |                |                               |
| Project DJ10   | Page 11 of 14 Pages  | Exhibit R-2 (PE 0602786A) |                |                               |



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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |                             |                   |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                     |                     |            |
|--|-----------------------------|-------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                             |                   |                     | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> |                     |                     |                     | PROJECT<br><b>D283</b>       |                     |                     |            |
| COST (In Thousands)  |                             | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate   | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate          | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
| D283   | Airdrop Advanced Technology | 1476              | 1630                | 1692  | 1903                | 1895                | 1960                | 1999                         | 2040                | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project provides exploratory development to enhance personnel and cargo airdrop capabilities. These are key capabilities for force projection, particularly into hostile areas. Areas of emphasis include parachute technology for improved performance, precision offset aerial delivery, soft landing system development, airdrop simulation, and low altitude/high speed airdrop systems technologies. Efforts will result in increased personnel safety and reduced personnel, aircraft, and cargo vulnerability.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 660 - Developed experimental methods for measuring parachute performance to validate parachute opening model and to provide reliable designs for low altitude airdrop systems. <ul style="list-style-type: none"> <li>- Applied computational fluid dynamics, trajectory analysis, advanced concepts and improved experimental techniques to enhance low altitude parachute performance.</li> <li>- Continued testing and development of the new canopy for low altitude heavy equipment drop.</li> <li>- Analyzed motion of paratroopers during initial parachute deployment to improve personnel airdrop safety.</li> </ul> </li> <li>• 816 - Conducted experimental and theoretical analysis of the opening dynamics and aerodynamics of large gliding wing parafoils to deploy at higher altitudes and greater lateral distances to reduce aircraft vulnerability. <ul style="list-style-type: none"> <li>- Partially completed virtual analysis of Guided Precision Aerial Delivery Systems (GPADS) precision delivery system, assessing warfighting benefit.</li> <li>- Continued experimentation on soft landing concepts of airbags and parachute retraction.</li> </ul> </li> </ul> <p>Total 1476</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 766 - Complete experimental and theoretical analysis of the opening of large deployable gliding wings for use at higher altitudes and greater lateral distances to reduce aircraft vulnerability. <ul style="list-style-type: none"> <li>- Conduct analysis and experiments on aerodynamics of gliding wings.</li> <li>- Continue full-scale testing of soft landing systems.</li> <li>- Demonstrate satisfactory flight performance of low bulk and light weight new parachutes.</li> <li>- Complete development of experimental methods for measuring parachute performance to validate parachute opening model and to provide reliable designs for high speed low altitude airdrop systems.</li> </ul> </li> <li>• 854 - Develop 3-D computer model to analyze inflation of round canopy parachutes and ram-air gliding wings to minimize full-scale airdrop testing. <ul style="list-style-type: none"> <li>- Continue motion analysis of paratroopers during initial parachute deployment to improve personnel airdrop safety.</li> </ul> </li> </ul> |                             |                   |                     |   |                     |                     |                     |                              |                     |                     |            |
| Project D283   |                             |                   |                     | Page 12 of 14 Pages   |                     |                     |                     | Exhibit R-2 (PE 0602786A)    |                     |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>   |
|---|--|--|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602786A Logistics Technology</b> PROJECT<br><b>D283</b> |  |
| <b>FY 1997 Planned Program: (continued)</b>   |  |  |
| <ul style="list-style-type: none"> <li>- Using the results of computational fluid dynamics and trajectory analyses, determine characteristics/factors that will enhance low altitude parachute performance.</li> <li>- Identify parameters for developing a model of human performance/biomechanics to improve parachutist's safety.</li> <li>- Analyze parachute collapse phenomenon to increase airdrop safety.</li> <li>- Complete virtual analysis of GPADS, assessing its warfighting benefits.</li> </ul> |  |  |
| •   | 10   | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |
| Total   | 1630   |  |
| <b>FY 1998 Planned Program:</b>   |  |  |
| <ul style="list-style-type: none"> <li>- Modify new low bulk and light weight parachutes to improve flight performance.</li> <li>- Conduct analysis and experiments on aerodynamics of gliding wings.</li> <li>- Demonstrate parachute retraction concept using clustered parachutes for soft landing of airdropped payloads.</li> <li>- Implement cold-gas injection and controlled venting to airbags for soft landing of airdropped payloads.</li> </ul>   |  |  |
| •   | 843  | - Complete motion analysis of paratroopers during initial parachute deployment to improve personnel airdrop safety.<br>- Continue analysis of parachute collapse phenomenon.<br>- Continue 3-D computer model development to analyze inflation of round canopy parachutes and ram-air gliding wings to minimize full-scale air drop testing. |
| Total   | 1692   |  |
| <b>FY 1999 Planned Program:</b>   |  |  |
| <ul style="list-style-type: none"> <li>- Apply 3-D computer model to analyze parachute performance and to minimize full-scale airdrop testing.</li> <li>- Complete motion analysis of cargo platforms.</li> <li>- Complete analysis of parachute collapse phenomenon to improve personnel airdrop safety.</li> <li>- Implement parachute and airdrop systems performance models to virtual battlefield simulation.</li> </ul>   |  |  |
| •   | 845  | - Conduct full-scale test of airbags equipped with cold-gas injection and controlled venting for soft landing of air dropped payloads.<br>- Apply new parachute concepts to large cargo parachutes.<br>- Investigate new design and construction concepts for parafoils to minimize costs.   |
| Total   | 1903   |  |
| Project D283  | <i>Page 13 of 14 Pages</i>   | Exhibit R-2 (PE 0602786A)  |

**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)** DATE **February 1997**

BUDGET ACTIVITY **2 - Applied Research** PE NUMBER AND TITLE **0602786A Logistics Technology** PROJECT **D283**

| <b>B. Project Change Summary</b>  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 1492           | 1665           | 1906           | 2151           |
| Appropriated Value                | 1546           | 1630           |                |                |
| Adjustments to Appropriated Value | -70            |                |                |                |
| FY 1998 Pres Bud Request          | 1476           | 1630           | 1692           | 1903           |

Change Summary Explanation: Funding: FY 1998 - Funding reprogrammed (-214) to higher priority requirements.  
FY 1999 - Funding reprogrammed (-248) to higher priority requirements.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |                   |                     |                     |   |                     |                     |                     |                     | DATE<br><b>February 1997</b> |            |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|---------------------|------------------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                     |                     |                              |            |
| <i>COST (In Thousands)</i>                                     | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete          | Total Cost |
| Total Program Element (PE) Cost                                | 70575             | 104332              | 74684               | 75307   | 72307               | 74149               | 74801               | 76014               | Continuing                   | Continuing |
| A825 Combat Maxillofacial Injury                               | 1003              | 504                 | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 1507       |
| A838 Neurotoxin Exposure Treatment                             | 0                 | 24477               | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 24477      |
| A839 Computer-Assisted Signaling Cancer Cell Proliferation     | 0                 | 2252                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 2252       |
| A841 Computer-Assisted Minimally Invasive Surgery              | 0                 | 2448                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 2448       |
| A842 ENT Minimally Invasive Simulation                         | 0                 | 979                 | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 979        |
| A843 Health Tech Roadmaps                                      | 0                 | 3427                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 3427       |
| A845 Bone Disease Research Program                             | 0                 | 9791                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 9791       |
| A863 Battlefield Surgical Replacement                          | 0                 | 1958                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 1958       |
| A870 DoD Medical Defense Against Infectious Diseases           | 25009             | 28799               | 28520               | 25753   | 24448               | 25420               | 26020               | 26634               | Continuing                   | Continuing |
| A872 Neurofibromatosis Research                                | 8000              | 0                   | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 8000       |
| D873 HIV Exploratory Research                                  | 2731              | 2869                | 21791               | 20576   | 19035               | 19056               | 18512               | 18411               | Continuing                   | Continuing |
| A874 Combat Casualty Care Technology                           | 11680             | 11176               | 8822                | 10159   | 9896                | 10087               | 10295               | 10530               | Continuing                   | Continuing |
| A878 Health Hazards of Military Materiel                       | 6808              | 7141                | 8012                | 9629  | 9934                | 10272               | 10466               | 10719               | Continuing                   | Continuing |
| A879 Medical Factors Enhancing Soldier Effectiveness           | 9769              | 8511                | 7539                | 9190  | 8994                | 9314                | 9508                | 9720                | Continuing                   | Continuing |
| A898 Wound Healing   | 1897              | 0                   | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 1897       |

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|  |   |
|--|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b> | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |
|--|---|

| COST ( <i>In Thousands</i> ) | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|------------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| A899 Emergency Medical Teams | 3678              | 0                   | 0                   | 0                   | 0                   | 0                   | 0                   | 0                   | 0                   | 3678       |

**Mission Description and Budget Item Justification:** This program element (PE) funds exploratory development in Department of Defense (DoD) 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. The primary goal of medical research and development is to sustain medical technology superiority to improve the protection and survivability of U.S. forces on conventional battlefields as well as in potential areas of low intensity conflict and military operations short of war. This program element is the core DoD technology base to develop methods and materials for: infectious disease prevention and treatment including vaccines, prophylactic and therapeutic drugs, insect repellents, and methods of diagnosis and identification of naturally occurring infectious diseases; prevention and treatment of combat maxillofacial (face and neck) injuries, and essential dental treatment on the battlefield; combat casualty care of trauma and burns due to weapons, organ system survival, shock resulting from blood loss and infection, blood preservation and potential blood substitutes for battlefield care; assessment of the health hazards of military materiel, and the sustainment or enhancement of soldier performance. The work in this PE is consistent with the 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 PE include non-system specific development efforts pointed toward specific military needs and are appropriate to Budget Activity 2.

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|-----|-----|-----|--------------------|------|-----|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|-----|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                           | PROJECT<br><b>A825</b>       |                     |            |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| A825 Combat Maxillofacial Injury   | 1003              | 504                 | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                   | 1507       |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| <p><b>A. Mission Description and Justification:</b> This project has as its major thrusts exploratory development of new/improved methods and materiel for rapid simplified treatment of face and neck wounds and provision of field dental treatment.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 506 Conducted clinical study comparing oral motor function of fracture patients treated by surgical means with those treated by non-surgical means.</li> <li>• 43 Evaluated efficacy of sustained-action and receptor-selective analgesics in animal models.</li> <li>• 454 Prepared hyper-speed parallel video camera for incorporation into robotic surgical assistant test bed.</li> </ul> <p>Total 1003</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 48 Evaluate toxicity of novel analgesics.</li> <li>• 443 Begin design of hyper-speed parallel computer interface to hyper-speed parallel camera for robotic surgical assistant test bed.</li> <li>• 13 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 504</p> <p><b>FY 1998 Planned Program:</b> Tasks and funding restructured to PE 0602787A, Project 874.</p> <p><b>FY 1999 Planned Program:</b> Tasks and funding restructured to PE 0602787A, Project 874.</p> <p><b>B. Project Change Summary</b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="center">1029</td> <td align="center">514</td> <td align="center">535</td> <td align="center">564</td> </tr> <tr> <td>Appropriated Value</td> <td align="center">1058</td> <td align="center">504</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="center">-55</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="center">1003</td> <td align="center">504</td> <td align="center">0</td> <td align="center">0</td> </tr> </tbody> </table> <p>Change Summary Explanation:<br/>           Funding: FY 1998: Tasks and funding (-535) restructured to PE 0602787A Project A874<br/>           FY 1999: Tasks and funding (-564) restructured to PE 0602787A Project A874</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1029 | 514 | 535 | 564 | Appropriated Value | 1058 | 504 |  |  | Adjustments to Appropriated Value | -55 |  |  |  | FY 1998 Pres Bud Request | 1003 | 504 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| FY 1997 President's Budget   | 1029              | 514                 | 535                 | 564   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| Appropriated Value   | 1058              | 504                 |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| Adjustments to Appropriated Value  | -55               |                     |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| FY 1998 Pres Bud Request   | 1003              | 504                 | 0                   | 0   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |
| Project A825   |                   |                     | Page 3 of 25 Pages  |   |                     |                     | Exhibit R-2 (PE 0602787A) |                              |                     |            |  |                |                |                |                |                            |      |     |     |     |                    |      |     |  |  |                                   |     |  |  |  |                          |      |     |   |   |

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|-------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|-------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                           |                     | PROJECT<br><b>A838</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| A838 Neurotoxin Exposure Treatment   | 0                 | 24477               | 0                   | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 24477      |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for neurotoxin exposure treatment.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 23879 Evaluated competitive contracts/grants to initiate research on neurotoxin exposure treatment.</li> <li>• 598 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 24477</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border: none;"> <tr> <td></td> <td align="center"><u>FY 1996</u></td> <td align="center"><u>FY 1997</u></td> <td align="center"><u>FY 1998</u></td> <td align="center"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">24477</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">24477</td> <td align="right">0</td> <td align="right">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+24477) provided by Congressional action.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 24477 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 24477 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| FY 1997 President's Budget   | 0                 | 0                   | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| Appropriated Value   | 0                 | 24477               |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| Adjustments to Appropriated Value  |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| FY 1998 Pres Bud Request   | 0                 | 24477               | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |
| Project A838   |                   |                     | Page 4 of 25 Pages  |   |                     | Exhibit R-2 (PE 0602787A) |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |       |  |  |                                   |  |  |  |  |                          |   |       |   |   |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |   |                    |                     |  |                     |                           |                     | DATE<br>February 1997 |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
|--|---|--------------------|---------------------|--|---------------------|---------------------------|---------------------|-----------------------|---------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| BUDGET ACTIVITY<br>2 - Applied Research  |   |                    |                     | PE NUMBER AND TITLE<br>0602787A Medical Technology |                     |                           |                     | PROJECT<br>A839       |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| COST (In Thousands)  |   | FY 1996<br>Actual  | FY 1997<br>Estimate | FY 1998<br>Estimate                                | FY 1999<br>Estimate | FY 2000<br>Estimate       | FY 2001<br>Estimate | FY 2002<br>Estimate   | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| A839   | Computer-Assisted Signaling Cancer Cell Proliferation | 0                  | 2252                | 0  | 0                   | 0                         | 0                   | 0                     | 0                   | 0                   | 2252       |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. Mission Description and Justification:</b> By Congressional direction, the purpose of this project is to develop initial research models for computer-assisted signaling cancer cell proliferation.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2197 Evaluated competitive contracts/grants to initiate research on computer assisted signaling cancer cell proliferation.</li> <li>• 55 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2252</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99</p> <p><b>B. Project Change Summary</b></p> <table border="0"> <thead> <tr> <th></th> <th align="right"><u>FY 1996</u></th> <th align="right"><u>FY 1997</u></th> <th align="right"><u>FY 1998</u></th> <th align="right"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">2252</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">2252</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+2252) provided by Congressional action.</p> |   |                    |                     |  |                     |                           |                     |                       |                     |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 2252 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 2252 | 0 | 0 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>     | <u>FY 1998</u>      | <u>FY 1999</u>                                     |                     |                           |                     |                       |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget   | 0   | 0                  | 0                   | 0  |                     |                           |                     |                       |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value   | 0   | 2252               |                     |  |                     |                           |                     |                       |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value  |   |                    |                     |  |                     |                           |                     |                       |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request   | 0   | 2252               | 0                   | 0  |                     |                           |                     |                       |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project A839   |   | Page 5 of 25 Pages |                     |  |                     | Exhibit R-2 (PE 0602787A) |                     |                       |                     |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |



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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                           |                     | PROJECT<br><b>A841</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| A841 Computer-Assisted Minimally Invasive Surgery   | 0                 | 2448                | 0                   | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 2448       |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for computer-assisted minimally invasive surgery.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2389 Evaluated competitive contracts/grants to initiate research on computer-assisted minimally invasive surgery.</li> <li>• 59 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2448</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <tr> <td></td> <td align="center"><u>FY 1996</u></td> <td align="center"><u>FY 1997</u></td> <td align="center"><u>FY 1998</u></td> <td align="center"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">2448</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">2448</td> <td align="right">0</td> <td align="right">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+2448) provided by Congressional action.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 2448 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 2448 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget  | 0                 | 0                   | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value  | 0                 | 2448                |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value   |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request  | 0                 | 2448                | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project A841  |                   |                     | Page 6 of 25 Pages  |   |                     | Exhibit R-2 (PE 0602787A) |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                |                  |                    |   |                  |                  |                           | DATE<br><b>February 1997</b> |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
|--|----------------|------------------|--------------------|---|------------------|------------------|---------------------------|------------------------------|------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|-----|--|--|-----------------------------------|--|--|--|--|--------------------------|---|-----|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                |                  |                    | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                  |                  |                           | PROJECT<br><b>A842</b>       |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate             | Cost to Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| A842 ENT Minimally Invasive Simulation   | 0              | 979              | 0                  | 0   | 0                | 0                | 0                         | 0                            | 0                | 979        |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for ENT. minimally invasive simulation.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 955 Evaluated competitive contracts/grants to initiate research on ENT. minimally invasive simulation.</li> <li>• 24 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 979</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">979</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">979</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+979) provided by Congressional action.</p> |                |                  |                    |   |                  |                  |                           |                              |                  |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 979 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 979 | 0 | 0 |
|  | <u>FY 1996</u> | <u>FY 1997</u>   | <u>FY 1998</u>     | <u>FY 1999</u>  |                  |                  |                           |                              |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| FY 1997 President's Budget   | 0              | 0                | 0                  | 0   |                  |                  |                           |                              |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Appropriated Value   | 0              | 979              |                    |   |                  |                  |                           |                              |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Adjustments to Appropriated Value  |                |                  |                    |   |                  |                  |                           |                              |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| FY 1998 Pres Bud Request   | 0              | 979              | 0                  | 0   |                  |                  |                           |                              |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Project A842   |                |                  | Page 7 of 25 Pages |   |                  |                  | Exhibit R-2 (PE 0602787A) |                              |                  |            |  |                |                |                |                |                            |   |   |   |   |                    |   |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                           |                     | PROJECT<br><b>A843</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| A843 Health Tech Roadmaps   | 0                 | 3427                | 0                   | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 3427       |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for health tech roadmaps.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3343 Evaluated competitive contracts/grants to initiate research on health tech roadmaps.</li> <li>• 84 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3427</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <tr> <td></td> <td align="center"><u>FY 1996</u></td> <td align="center"><u>FY 1997</u></td> <td align="center"><u>FY 1998</u></td> <td align="center"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td align="center">0</td> <td align="center">0</td> <td align="center">0</td> <td align="center">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="center">0</td> <td align="center">3427</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="center">0</td> <td align="center">3427</td> <td align="center">0</td> <td align="center">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+3427) provided by Congressional action.</p> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 3427 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 3427 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget  | 0                 | 0                   | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value  | 0                 | 3427                |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value   |                   |                     |                     |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request  | 0                 | 3427                | 0                   | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project A843  |                   |                     | Page 8 of 25 Pages  |   |                     | Exhibit R-2 (PE 0602787A) |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                     | PROJECT<br><b>A845</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| A845 Bone Disease Research Program  | 0                 | 9791                | 0                   | 0   | 0                   | 0                   | 0                   | 0                            | 0                   | 9791       |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for bone disease research program.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9552 Evaluated competitive contracts/grants to initiate research on bone disease research program.</li> <li>• 239 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 9791</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border: none;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">9791</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">9791</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+9791) provided by Congressional action.</p> |                   |                     |                     |   |                     |                     |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 9791 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 9791 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget  | 0                 | 0                   | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value  | 0                 | 9791                |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value   |                   |                     |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request  | 0                 | 9791                | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                           | PROJECT<br><b>A863</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| A863 Battlefield Surgical Replacement   | 0                 | 1958                | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                   | 1958       |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> This research is directed towards development of equipment and bio-material for use in repairing trauma and burn injuries in the field.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1910 Development of equipment and bio material to repair trauma and burn injuries in the field.</li> <li>• 48 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1958</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">1958</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">1958</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+1958) provided by Congressional action.</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 1958 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 1958 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget  | 0                 | 0                   | 0                   | 0   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value  | 0                 | 1958                |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value   |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request  | 0                 | 1958                | 0                   | 0   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project A863  |                   |                     | Page 10 of 25 Pages |   |                     |                     | Exhibit R-2 (PE 0602787A) |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |   |                   |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                     |                     |            |
|---|---|-------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |   |                   |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                     | PROJECT<br><b>A870</b>       |                     |                     |            |
| COST (In Thousands)   |   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate                                       | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate          | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
| A870  | DoD Medical Defense Against Infectious Diseases | 25009             | 28799               | 28520   | 25753               | 24448               | 25420               | 26020                        | 26634               | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 10846 Prepared malaria vaccines and tested them in animals; prepared and evaluated prophylactic/therapeutic drugs to address resistant parasites; evaluated insecticide barrier and repellent methods of protection from insect vectors. Transitioned to Milestone 0 one antimalarial vaccine, one antileishmanial drug and one <i>Leishmania</i> skin test.</li> <li>• 6197 Constructed and evaluated candidate vaccines against <i>shigella</i>, <i>Enterotoxigenic Escherichia coli</i>, and <i>Campylobacter</i> using novel methodology. Transitioned to Milestone 0 one antishigella vaccine, and one antiscrub typhus drug.</li> <li>• 7246 Prepared and evaluated killed and recombinant vaccine candidates for <i>dengue</i>; evaluated deployable diagnostic tests.</li> <li>• 720 Evaluated antibiotic resistance in clinical scrub typhus isolates.</li> </ul> <p>Total 25009</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2766 Conduct an analysis of the adjuvant systems used with RTS,S and begin a two year study to determine the immunological basis for immunity induced by irradiated sporozoites.</li> <li>• 1801 Conduct epitope mapping to identify protective antigens of <i>Shigella</i>, microencapsulate mutant labile toxin, and determine the range of cross serotype protection in <i>Campylobacter</i>.</li> <li>• 1308 Perform absorption, distribution, metabolism, and excretion studies of candidate antiparasitic drugs to satisfy FDA requirements.</li> <li>• 1469 Use genetic engineering technology to isolate, clone, and produce <i>dengue</i> fever antigens. Determine which nucleic acid sequences are the most promising for incorporation into a DNA vaccine to prevent <i>dengue</i> fever.</li> <li>• 1352 Optimize a wet antigen capture assay for rapid detection of drug resistant malaria, and compare reagents for a new skin test for excreted factor of <i>Leishmania</i>. Investigate technologies and establish databases that will lead to the development of a computerized vector identification key.</li> <li>• 616 Incorporate purified meningococcal outer membrane proteins and lipopolysaccharides into liposomes to improve the parental meningitis vaccine. Optimize the hand held assay for scrub typhus.</li> </ul> <p><b>FY 1997 Planned Program: (continued)</b></p> |   |                   |                     |   |                     |                     |                     |                              |                     |                     |            |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) |   | DATE                      |
|---|---|---------------------------|
| BUDGET ACTIVITY                                     |   | PROJECT                   |
| <b>2 - Applied Research</b>                         |   | <b>A870</b>               |
| PE NUMBER AND TITLE                                 |   |                           |
| <b>0602787A Medical Technology</b>                  |   |                           |
| •   | 1506 Produce candidate reagents for the immunotherapy of hemorrhagic viruses. Construct a prototype multigene hepatitis E DNA vaccine for testing in animals.   |                           |
| •   | 12651 Enhance capabilities in production and delivery methods for vaccines including liposome and microencapsulation technology, and begin the two year program to construct and test the forward deployable malaria diagnostic device. Pay administrative overhead costs at the WRAIR.                                   |                           |
| •   | 5171 Pay transition costs of moving the WRAIR into a new facility.  |                           |
| •   | 159 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                           |
| Total   | 28799   |                           |
| <b>FY 1998 Planned Program:</b>                     |   |                           |
| •   | 2931 Complete the analysis of the adjuvant systems used with RTS,S and the two year study to determine the immunological basis for immunity induced by irradiated sporozoites.  |                           |
| •   | 1894 Begin the construction of <i>Shigella dysenteriae</i> vaccine candidates, produce and purify recombinant <i>E. coli</i> antigens, and construct a live-attenuated <i>Campylobacter</i> vaccine candidate.  |                           |
| •   | 922 Begin the validation process of a new method for structure-based drug design. Prepare candidate drugs for <i>in vivo</i> testing.   |                           |
| •   | 1329 Construct a tetravalent killed whole virus <i>dengue</i> vaccine candidate. Select nucleic acid sequences of interest.   |                           |
| •   | 1296 Optimize a quantitative dry dipstick assay for rapid detection of drug resistant malaria, and begin the optimization of the ELISA diagnostic device for <i>Leishmania</i> infections. Under laboratory conditions, test the most promising compounds to replace DEET insect repellent.                               |                           |
| •   | 387 Improve the mucosal meningitis vaccine by using native outer membrane vesicles without removal of the lipopolysaccharides. Begin the two year program to identify antibiotic resistance genes for scrub typhus.   |                           |
| •   | 1342 Optimize the polyvalent vaccine candidate to prevent <i>Hantavirus</i> infections. Evaluate the simultaneous immunization of personnel against hepatitis viruses.  |                           |
| •   | 12639 Enhance capabilities in production and delivery methods for vaccines including conjugation technology, and complete testing of a forward deployable malaria diagnostic device. Pay administrative overhead costs at the Walter Reed Army Institute of Research (WRAIR).   |                           |
| •   | 5780 Pay transition costs of moving the WRAIR into a new facility.  |                           |
| Total   | 28520   |                           |
| <b>FY 1999 Planned Program:</b>                     |   |                           |
| •   | 3210 Begin investigations on how to best combine vaccine candidates for both <i>P. falciparum</i> and <i>P. vivax</i> into one vaccine.   |                           |
| •   | 2231 Begin studies on how best to construct a trivalent <i>Shigella</i> vaccine, optimize formulations that include both <i>E. coli</i> antigens and mucosal adjuvants in the same microsphere, develop animal models to investigate a possible link between Guillain-Barre syndrome and <i>Campylobacter</i> infections. |                           |
| •   | 1010 Complete <i>in vitro</i> testing of a new drug to treat multi drug-resistant malaria (artelinic acid) and a new drug to prevent multi drug-resistant malaria (acridine analog).  |                           |
| <b>FY 1999 Planned Program: (continued)</b>         |   |                           |
| Project A870  |   | Exhibit R-2 (PE 0602787A) |





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|--|-------------------|---------------------|----------------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|--|--|--|-----------------------------------|--|--|--|--|--------------------------|------|---|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                            |   |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                            | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                           |                     | PROJECT<br><b>A872</b>       |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| A872 Neurofibromatosis Research  | 8000              | 0                   | 0                          | 0   | 0                   | 0                         | 0                   | 0                            | 0                   | 8000       |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for neurofibromatosis.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 8000 Began the process to award competitive contracts/grants to initiate research on neurofibromatosis.</li> </ul> <p>Total 8000</p> <p><b>FY 1997 Planned Program:</b> Program not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="margin-left: 40px;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1996</u></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">0</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">8000</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1996: Funding (+8000) transferred from the Defense Health Program by Congressional direction.</p> |                   |                     |                            |   |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 |  |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 8000 | 0 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>             | <u>FY 1999</u>  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| FY 1997 President's Budget   | 0                 | 0                   | 0                          | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| Appropriated Value   | 0                 |                     |                            |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| Adjustments to Appropriated Value  |                   |                     |                            |   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| FY 1998 Pres Bud Request   | 8000              | 0                   | 0                          | 0   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |
| Project A872   |                   |                     | <i>Page 14 of 25 Pages</i> |   |                     | Exhibit R-2 (PE 0602787A) |                     |                              |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |  |  |  |                                   |  |  |  |  |                          |      |   |   |   |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |                          |                |                  |   |                  |                  |                  | DATE<br><b>February 1997</b> |                  |                  |            |
|--|--------------------------|----------------|------------------|---|------------------|------------------|------------------|------------------------------|------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                          |                |                  | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                  |                  |                  | PROJECT<br><b>D873</b>       |                  |                  |            |
| COST (In Thousands)  |                          | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate  | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate             | FY 2003 Estimate | Cost to Complete | Total Cost |
| D873   | HIV Exploratory Research | 2731           | 2869             | 21791   | 20576            | 19035            | 19056            | 18512                        | 18411            | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 934 Evaluated the effectiveness of candidate HIV vaccines.</li> <li>• 240 Established a significant protective effect (&gt;50%) of HIV-2 infection for subsequent HIV-1 infection in humans.</li> <li>• 832 Defined viral and immunogenic markers that distinguish rapid and slow rates of HIV disease progression.</li> <li>• 725 Conducted cohort feasibility studies in various locations in Thailand.</li> </ul> <p>Total 2731</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 463 Conduct vaccination/challenge studies of HIV candidate vaccines and bacterial and viral delivery systems in animal models to determine the effect of vaccine formulation and regimen.</li> <li>• 463 Determine correlates of immunity and identify less virulent strains of HIV to assist in vaccine construction.</li> <li>• 463 Evaluate live attenuated HIV-1 for clinical development potential.</li> <li>• 1410 Improve vaccine candidate diversification to increase coverage of global variants.</li> <li>• 70 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 2869</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4691 Conduct animal model and other preclinical studies of candidate vaccines (including complex protein, subunit, recombinant, DNA, and inactivated whole virus candidates) to prevent infection with HIV. Conduct Phase 1 vaccine trials in Thailand.</li> <li>• 3100 Develop and maintain international and domestic laboratories to support efficacy trials. Includes quality control and standardization of laboratory assays.</li> <li>• 3400 Prepare for efficacy testing by conducting cohort development including identifying high incidence groups and coordinating the efforts of regulatory agencies and scientific collaborators as they relate to populations at risk.</li> </ul> |                          |                |                  |   |                  |                  |                  |                              |                  |                  |            |
| Project D873   |                          |                |                  | Page 15 of 25 Pages                                       |                  |                  |                  | Exhibit R-2 (PE 0602787A)    |                  |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |       | DATE<br><b>February 1997</b>   |                |
|--|-------|--|----------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>                 |       | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b>  |                |
|  |       | PROJECT<br><b>D873</b>   |                |
| <b>FY 1998 Planned Program: (continued)</b>                    |       |  |                |
| •  | 3100  | Conduct national and international surveillance of HIV genotypes, conduct threat analysis of HIV stains, and characterize HIV specific epitopes to construct candidate vaccines for national and international use.                                    |                |
| •  | 2100  | Conduct studies of the natural history of HIV disease to determine vaccine trial endpoints. Expand the natural history data base and maintain a repository of sera samples.  |                |
| •  | 2200  | Improve vaccine candidates by investigating molecular conformation of protein antigens, role of specific cell receptors and viral correlates in infectivity and pathogenicity.   |                |
| •  | 2000  | Conduct studies on the clinical management of HIV by immune reconstitution.  |                |
| •  | 1200  | Conduct studies on HIV antiviral drugs, resistance evaluation, and rapid diagnosis of HIV infection.   |                |
| Total  | 21791 |  |                |
| <b>FY 1999 Planned Program:</b>                                |       |  |                |
| •  | 4391  | Evaluate animal model and other preclinical studies of candidate vaccines (including complex protein, subunit, recombinant, DNA, and inactivated whole virus candidates) to prevent infection with HIV. Conduct additional Phase 1 trials in Thailand. |                |
| •  | 3100  | Continue to upgrade and support international and domestic laboratories to support efficacy trials. Ensure quality control and standardization of laboratory assays.   |                |
| •  | 3200  | Prepare for Phase 3 trials by conducting cohort development including identifying high incidence groups and coordinating the efforts of regulatory agencies and scientific collaborators as they related to populations at risk.                       |                |
| •  | 3100  | Conduct national and international surveillance of HIV genotypes, conduct threat analysis of HIV stains, and characterize HIV specific epitopes to construct candidate vaccines for national and international use.                                    |                |
| •  | 2100  | Conduct studies of the natural history of HIV disease to determine vaccine trial endpoints. Expand the natural history data base and maintain a repository of sera samples.  |                |
| •  | 2100  | Improve vaccine candidates by investigating molecular conformation of protein antigens, role of specific cell receptors and viral correlates in infectivity and pathogenicity.   |                |
| •  | 1800  | Complete and evaluate initial studies on the clinical management of HIV by immune reconstitution.  |                |
| •  | 785   | Conduct studies on HIV antiviral drugs, resistance evaluation, and rapid diagnosis of HIV infection. Continue to monitor the appearance of drug resistance and prepare to implement rapid diagnosis of HIV infection.                                  |                |
| Total  | 20576 |  |                |
| <b>B. Project Change Summary</b>                               |       |  |                |
|  |       | <u>FY 1996</u>   | <u>FY 1997</u> |
| FY 1997 President's Budget                                     |       | 2801   | 2931           |
| Appropriated Value   |       | 2879   | 2869           |
| Adjustments to Appropriated Value                              |       | -148   |                |
| FY 1998 Pres Bud Request                                       |       | 2731   | 2869           |
|  |       |  | <u>FY 1998</u> |
|  |       |  | 3054           |
|  |       |  | <u>FY 1999</u> |
|  |       |  | 3235           |
|  |       | 21791  | 20576          |

DATE  
**February 1997**

BUDGET ACTIVITY  
**2 - Applied Research**

PE NUMBER AND TITLE  
**0602787A Medical Technology**

Change Summary Explanation:

Funding: FY98: Funding increased (+18300) to provide increased emphasis on research into HIV/AIDS.

FY99: Funding increased (+16900) to provide increased emphasis on research into HIV/AIDS.

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                |                  |                  |  |                  |                  |                  | DATE<br>February 1997 |                  |            |
|---|----------------|------------------|------------------|--|------------------|------------------|------------------|-----------------------|------------------|------------|
| BUDGET ACTIVITY<br>2 - Applied Research   |                |                  |                  | PE NUMBER AND TITLE<br>0602787A Medical Technology |                  |                  |                  | PROJECT<br>A874       |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate                                   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate      | Cost to Complete | Total Cost |
| A874 Combat Casualty Care Technology  | 11680          | 11176            | 8822             | 10159  | 9896             | 10087            | 10295            | 10530                 | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project funds the core technology base to develop concepts, techniques and material for the treatment and return-to-duty of soldiers wounded in combat and to support Low Intensity Combat as well as military operations other than war. This project addresses investigation of the treatments for weapons-induced trauma and burns, and shock due to blood loss. It also funds technologies for resuscitation fluid and blood preservation.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1195 Conducted production of purified and chemically modified hemoglobins and characterized their physiological effects in animal models.</li> <li>• 820 Determined the efficacy and safety of red cells stored for eight weeks in standard refrigeration; prepared for transition to advanced development; identified optimal fibrin sealant formulations for hemorrhage control; explored methods for lyophilized storage of platelets.</li> <li>• 3613 Defined requirements for oxygen administration to hemorrhaging individuals in an animal model; characterized physiological effects of moderate hypothermia and heat shock protein induction as protective measures against hemorrhagic shock and organ failure.</li> <li>• 795 Demonstrated <i>in vivo</i> neuroprotective efficacy of lead candidate dextromethorphan and carbetapentane analogs in rodent models to justify advanced clinical development.</li> <li>• 405 Determined the efficacy of immune therapy (antibodies to lipopolysaccharide) in the treatment of septic shock, using appropriate animal models.</li> <li>• 463 Conducted prototype resuscitation pump and bench testing; evaluated feasibility of servo-controlled resuscitation in large animal models.</li> <li>• 4389 Explored clinical efficacy and safety of countermeasures to burn and inhalation injury, including skin grafting materials, synthetic pulmonary surfactants, and antimicrobial agents.</li> </ul> <p>Total 11680</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 183 Identify best approaches for increasing the life span of whole blood in refrigerated storage.</li> <li>• 1635 Evaluate methods of hypothermia induction for protection against shock; determine effects of hibernation vs. hypothermia on cell metabolism and analyze risks vs. benefits; explore pharmacological inducers of heat shock proteins.</li> <li>• 1391 Characterize biochemical and pharmacological mechanisms of traumatic brain injury and define effects of potential countermeasures; define <i>in vivo</i> neuroprotective efficacy of lead candidate dextromethorphan and carbetapentane analogs in large animal models to justify advanced clinical development.</li> <li>• 1481 Conduct evaluations of candidate cartilage repair techniques, to correct battle or training injuries to joints.</li> <li>• 229 Evaluate efficacy of microencapsulated anesthetic and analgesic compounds in animal models.</li> </ul> <p><b>FY 1997 Planned Program: (continued)</b></p> |                |                  |                  |  |                  |                  |                  |                       |                  |            |

Project A874

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |       | DATE<br><b>February 1997</b>  |                |                           |                |
|---|-------|---|----------------|---------------------------|----------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |       | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b>   |                |                           |                |
|   |       | PROJECT<br><b>A874</b>  |                |                           |                |
| •   | 1156  | Develop interfaces and controllers to link medical sensors to monitoring systems (Soldier Individual Computer or other dedicated system).   |                |                           |                |
| •   | 1056  | Evaluate use of silver-nylon fabric as an antimicrobial wound dressing.   |                |                           |                |
| •   | 3846  | Evaluate non-invasive sensor, Life Support for Trauma and Transport (LSTAT), Advanced Surgical Suite for Trauma Casualties (ASSTC) digital surgical facility and other advance technology prototypes. |                |                           |                |
| •   | 199   | Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                |                           |                |
| Total   | 11176 |   |                |                           |                |
| <b>FY 1998 Planned Program:</b>   |       |   |                |                           |                |
| •   | 1493  | Verify early versus delayed fluid resuscitation therapy following massive hemorrhage associated with penetrating trauma.  |                |                           |                |
| •   | 1455  | Evaluate serine protease inhibitors as a candidate drug for prevention of ischemia/reperfusion injury in brain and spinal cord.   |                |                           |                |
| •   | 1182  | Evaluate effectiveness of silver-coated pins for far forward fracture fixation and stabilization.   |                |                           |                |
| •   | 1408  | Determine feasibility of Laser Burn Debridement in models of military relevant burns or other appropriate wounds.   |                |                           |                |
| •   | 2346  | Continue evaluating and refining sensors, surgical and evacuation technology, including LSTAT and ASSTC (listed above).   |                |                           |                |
|   | 938   | Begin evaluation of miniature version of LSTAT = miniSTAT as far forward intensive care and diagnostic support platform.  |                |                           |                |
| Total   | 8822  |   |                |                           |                |
| <b>FY 1999 Planned Program:</b>   |       |   |                |                           |                |
| •   | 3182  | Evaluate various phospholipase A2 inhibitors and serine protease inhibitors for prevention of ischemia/reperfusion injury in brain, spinal cord, and other organs.                                    |                |                           |                |
| •   | 3987  | Evaluate various oxygen free radical scavengers for their ability to mitigate ischemia/reperfusion injury in central nervous and other soft tissues.  |                |                           |                |
| •   | 2990  | Evaluate use of Laser Burn Debridement in military relevant burns or other appropriate wounds.  |                |                           |                |
| Total   | 10159 |   |                |                           |                |
| <b>B. Project Change Summary</b>  |       |   |                |                           |                |
|   |       | <u>FY 1996</u>  | <u>FY 1997</u> | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget  |       | 11916   | 11415          | 10444                     | 10607          |
| Appropriated Value  |       | 12249   | 11176          |                           |                |
| Adjustments to Appropriated Value   |       | -569  |                |                           |                |
| FY 1998 Pres Bud Request  |       | 11680   | 11176          | 9401                      | 10192          |
| Change Summary Explanation: Funding: FY 1998: Funds reprogrammed (-1043) to higher priority programs. |       |   |                |                           |                |
| Project A874  |       | Page 19 of 25 Pages   |                | Exhibit R-2 (PE 0602787A) |                |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                                     |                   |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                     |                     |            |
|---|-------------------------------------|-------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                                     |                   |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                     | PROJECT<br><b>A878</b>       |                     |                     |            |
| COST (In Thousands)   |                                     | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate                                       | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate          | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
| A878  | Health Hazards of Military Materiel | 6808              | 7141                | 8012  | 9629                | 9934                | 10272               | 10466                        | 10719               | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> 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 over pressure 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 721 Determined guidelines to minimize eye-strain with extended use of vision enhancement devices.</li> <li>• 1206 Published field guide to prevent environmental injury in hot, wet, tropical environments.</li> <li>• 1400 Developed safe exposure criteria for frequency agile lasers.</li> <li>• 1230 Characterized health risks from combustion products of new artillery system.</li> <li>• 2251 Determined validated tolerance limits for shoulder-fired anti-armor weapons fired from enclosures.</li> </ul> <p>Total 6808</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 878 Develop blast overpressure injury model for generic blast health hazards assessments.</li> <li>• 146 Demonstrate effectiveness of individual soldier medical monitoring system in preventing heat and cold injury.</li> <li>• 1707 Characterize the health hazards of electromagnetic pulse from prototype electro-magnetic weapon systems.</li> <li>• 1498 Characterize effects of likely concurrent exposure to multiple chemicals from Army systems.</li> <li>• 2737 Demonstrate efficacy of early-phase anti-inflammatory therapy for treatment of laser eye injury.<br/>Complete dose response curve model for mechanical jolt and repeated impacts.</li> <li>• 175 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 7141</p> |                                     |                   |                     |   |                     |                     |                     |                              |                     |                     |            |
| Project A878  |                                     |                   |                     | Page 20 of 25 Pages                                       |                     |                     |                     | Exhibit R-2 (PE 0602787A)    |                     |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|---|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> | PROJECT<br><b>A878</b>       |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2355 Establish performance-based models characterizing levels of visual impairment pertinent to battlefield laser injury.</li> <li>• 1551 Field effective means to optimize aircrew endurance during sustained rotary-winged flight operations without aircrew performance decrements.</li> <li>• 2817 Develop biofidelic models for head and neck response to biodynamic forces.</li> <li>• 1289 Develop near-real time toxic hazard assessments of non-agent chemical exposures.</li> </ul> <p>Total 8012</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2723 Develop and test field therapy kits for laser retinal therapy.</li> <li>• 1832 Investigate the effects of three dimensional audio on improving aviators' communications performance.</li> <li>• 3161 Field improved human tolerance criteria for head impact protection in air and ground combat vehicles.</li> <li>• 1913 Develop near-real time toxic hazard assessments of non-agent chemical exposures.</li> </ul> <p>Total 9629</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">6984</td> <td style="text-align: center;">7294</td> <td style="text-align: center;">7745</td> <td style="text-align: center;">8227</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">7181</td> <td style="text-align: center;">7141</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-197</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">6808</td> <td style="text-align: center;">7141</td> <td style="text-align: center;">8012</td> <td style="text-align: center;">9629</td> </tr> </tbody> </table> <p>Change Summary Explanation:<br/>           Funding: FY 1999: Funds reprogrammed (+1402) into this project to fund the remainder of the U.S. Army Biomedical Research and Development Laboratory that was restored in BRAC 95.</p> |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 6984 | 7294 | 7745 | 8227 | Appropriated Value | 7181 | 7141 |  |  | Adjustments to Appropriated Value | -197 |  |  |  | FY 1998 Pres Bud Request | 6808 | 7141 | 8012 | 9629 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 6984  | 7294                         | 7745           | 8227           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 7181  | 7141                         |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -197  |                              |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 6808  | 7141                         | 8012           | 9629           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project A878  | Page 21 of 25 Pages                                       | Exhibit R-2 (PE 0602787A)    |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                           | PROJECT<br><b>A879</b>       |                     |            |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A879 Medical Factors Enhancing Soldier Effectiveness   | 9769              | 8511                | 7539                | 9190  | 8994                | 9314                | 9508                      | 9720                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2500 Conducted preliminary tests with Norwegian ranger students to evaluate physiological norms for noninvasive sensor telemetry.</li> <li>• 1562 Identified biomedical and mission factors affecting work and performance at high terrestrial altitudes.</li> <li>• 3707 Demonstrated behavioral and materiel means to reduce musculoskeletal injuries during military operations.</li> <li>• 2000 Developed new visual assessment and selection test to assess capabilities and visual loss in aviators.</li> </ul> <p>Total 9769</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4857 Develop new safety tables for immersion exposure based on modeling data from U.S. Army Ranger students.</li> <li>• 2440 Demonstrate behavioral and pharmacological strategies to enhance thermoregulation in hot and cold environments.</li> <li>• 1147 Develop recommendations for a single set of body fat standards for the services which enhance and do not impair readiness.</li> <li>• 67 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 8511</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2548 Determine the regional brain effects of alertness enhancing and sleep-inducing medications using brain imaging techniques.</li> <li>• 931 Determine critical factors relating Army family support and soldier mental health and performance during long-term deployments.</li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project A879   |                   |                     | Page 22 of 25 Pages |   |                     |                     | Exhibit R-2 (PE 0602787A) |                              |                     |            |

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|--|---|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|-------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> | PROJECT<br><b>A879</b>       |                |                |                |                |                |                            |      |      |      |      |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 2316 Integrate real-time satellite-derived weather data into thermal strain decision aids for battlefield commanders.</li> <li>• 1744 Develop training strategies and countermeasures to prevent stress fractures.</li> </ul> <p>Total 7539</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3103 Validate a new continuous operations simulation designed to demonstrate and refine the sleep-induction/rapid re-awakening and stimulant components of the Sleep Management System.</li> <li>• 3174 Test field-ready combined biochemical, physiological and psychometric stress diagnostics for potential far-forward use in real-time assessment to identify severely stressed soldiers at risk for combat stress reaction.</li> <li>• 1000 Develop strategies for the Air and Land Warrior programs to modify skin blood flow to maximize the effectiveness of microclimate cooling/heating.</li> <li>• 1913 Develop countermeasures to performance decrements from spatial disorientation during night vision assisted flight.</li> </ul> <p>Total 9190</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9901</td> <td style="text-align: center;">8693</td> <td style="text-align: center;">9245</td> <td style="text-align: center;">9682</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">10177</td> <td style="text-align: center;">8511</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-408</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">9769</td> <td style="text-align: center;">8511</td> <td style="text-align: center;">7539</td> <td style="text-align: center;">9190</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1998: Funds reprogrammed (-1706) to higher priority programs.</p> |   |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9901 | 8693 | 9245 | 9682 | Appropriated Value | 10177 | 8511 |  |  | Adjustments to Appropriated Value | -408 |  |  |  | FY 1998 Pres Bud Request | 9769 | 8511 | 7539 | 9190 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 9901  | 8693                         | 9245           | 9682           |                |                |                |                            |      |      |      |      |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 10177   | 8511                         |                |                |                |                |                |                            |      |      |      |      |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -408  |                              |                |                |                |                |                |                            |      |      |      |      |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 9769  | 8511                         | 7539           | 9190           |                |                |                |                            |      |      |      |      |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project A879   | Page 23 of 25 Pages                                       | Exhibit R-2 (PE 0602787A)    |                |                |                |                |                |                            |      |      |      |      |                    |       |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|--|--|--|-----------------------------------|------|--|--|--|--------------------------|------|---|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                     | PROJECT<br><b>A898</b>       |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| A898 Wound Healing  | 1897              | 0                   | 0                   | 0   | 0                   | 0                   | 0                   | 0                            | 0                   | 1897       |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for advanced methods of promoting wound healing.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1897 Evaluated competitive contracts/grants to initiate research on wound healing.</li> </ul> <p>Total 1897</p> <p><b>FY 1997 Planned Program:</b> Program not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; margin-left: 40px;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">1946</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">2000</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-103</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">1897</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> |                   |                     |                     |   |                     |                     |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1946 | 0 | 0 | 0 | Appropriated Value | 2000 |  |  |  | Adjustments to Appropriated Value | -103 |  |  |  | FY 1998 Pres Bud Request | 1897 | 0 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1997 President's Budget  | 1946              | 0                   | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Appropriated Value  | 2000              |                     |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Adjustments to Appropriated Value   | -103              |                     |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1998 Pres Bud Request  | 1897              | 0                   | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|--|--|--|-----------------------------------|------|--|--|--|--------------------------|------|---|---|---|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0602787A Medical Technology</b> |                     |                     |                     | PROJECT<br><b>A899</b>       |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate                                       | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| A899 Emergency Medical Teams   | 3678              | 0                   | 0                   | 0   | 0                   | 0                   | 0                   | 0                            | 0                   | 3678       |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for emergency medical teams.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3678 Awarded competitive contracts/grants to initiate research on emergency medical teams.</li> </ul> <p>Total 3678</p> <p><b>FY 1997 Planned Program:</b> Program not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">3772</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3878</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-200</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">3678</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> |                   |                     |                     |   |                     |                     |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 3772 | 0 | 0 | 0 | Appropriated Value | 3878 |  |  |  | Adjustments to Appropriated Value | -200 |  |  |  | FY 1998 Pres Bud Request | 3678 | 0 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1997 President's Budget   | 3772              | 0                   | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Appropriated Value   | 3878              |                     |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Adjustments to Appropriated Value  | -200              |                     |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1998 Pres Bud Request   | 3678              | 0                   | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |

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|---|-------------------|---------------------|--------------------------|--|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                          |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>  |                   |                     |                          | PE NUMBER AND TITLE<br><b>0602789A Army Artificial Intelligence Technology</b> |                     |                           |                     | PROJECT<br><b>A880</b>       |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| A880 Army Artificial Intelligence Technology  | 2054              | 2179                | 855                      | 1330   | 1320                | 1399                      | 1439                | 1484                         | Continuing          | Continuing |
| <p><b>A. Mission Description and Budget Item Justification:</b> 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 missions. 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. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Force XXI. This project includes non-system specific development efforts pointed toward specific military needs and therefore is appropriate to Budget Activity 2. This program is overseen by the U.S. Army AI Program General Officer Steering Committee (GOSC) and is managed primarily by the US Army AI Center, Pentagon.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2054 - Demonstrated use of AI technology in integrating vastly different data and technologies to solve highly complex problems.</li> <li style="margin-left: 20px;">- Demonstrated effectiveness of hybrid systems within manufacturing and robotics domains.</li> <li style="margin-left: 20px;">- Investigated integration of hybrid systems within synthetic environments for command and control AI systems.</li> <li style="margin-left: 20px;">- Demonstrated the integration of hybrid systems for the testing and evaluation of AI systems.</li> </ul> <p>Total 2054</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2126 - Demonstrate use of AI technology in integrating vastly different data and technologies to solve highly complex problems.</li> <li style="margin-left: 20px;">- Demonstrate effectiveness of hybrid systems within manufacturing and robotics domains.</li> <li style="margin-left: 20px;">- Investigate integration of hybrid systems within synthetic environments for command and control AI systems.</li> <li style="margin-left: 20px;">- Demonstrate the integration of hybrid systems for the testing and evaluation of AI systems.</li> <li style="margin-left: 20px;">- Investigate the application of Intelligent Agent Technology in AI systems supporting Force XXI.</li> </ul> <p style="margin-left: 20px;">53 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</p> <p>Total 2179</p> |                   |                     |                          |  |                     |                           |                     |                              |                     |            |
| Project A880  |                   |                     | <i>Page 1 of 2 Pages</i> |  |                     | Exhibit R-2 (PE 0602789A) |                     |                              |                     |            |

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|--|--|------------------------------|----------------|----------------|
| BUDGET ACTIVITY<br><b>2 - Applied Research</b>   | PE NUMBER AND TITLE<br><b>0602789A Army Artificial Intelligence Technology</b> | PROJECT<br><b>A880</b>       |                |                |
| <b>FY 1998 Planned Program:</b>  |  |                              |                |                |
| <ul style="list-style-type: none"> <li>● 855 - Demonstrate use of AI technology in integrating vastly different data and technologies to solve highly complex problems.</li> <li style="padding-left: 20px;">- Demonstrate effectiveness of hybrid systems within manufacturing and robotics domains.</li> <li style="padding-left: 20px;">- Demonstrate the effectiveness of Intelligent Agents in enhancing human performance.</li> <li style="padding-left: 20px;">- Investigate AI based prognostics technology for logistics and maintenance.</li> </ul> <p>Total 855</p>   |  |                              |                |                |
| <b>FY 1999 Planned Program:</b>  |  |                              |                |                |
| <ul style="list-style-type: none"> <li>● 1330 - Demonstrate use of AI technology in integrating vastly different data and technologies to solve highly complex problems.</li> <li style="padding-left: 20px;">- Demonstrate effectiveness of hybrid systems within manufacturing and robotics domains.</li> <li style="padding-left: 20px;">- Investigate integration of hybrid systems within synthetic environments for command and control AI systems.</li> <li style="padding-left: 20px;">- Demonstrate the integration of hybrid systems for the testing and evaluation of AI systems.</li> <li style="padding-left: 20px;">- Demonstrate the effectiveness of AI based prognostics systems in achieving "just-in-time" supply and maintenance.</li> </ul> <p>Total 1330</p> |  |                              |                |                |
| <b>B. Project Change Summary</b>   |  |                              |                |                |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 2107   | 2226                         | 2645           | 3317           |
| Appropriated Value   | 2166   | 2179                         |                |                |
| Adjustments to Appropriated Value  | -112   |                              |                |                |
| FY 1998 Pres Bud Request   | 2054   | 2179                         | 855            | 1330           |
| Change Summary Explanation: Funding: FY 1998 funds reprogrammed (-1790) to higher priority requirements.<br>FY 1999 funds reprogrammed (-1987) to higher priority requirements.  |  |                              |                |                |

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|---|---|-------------------|---------------------|---|---------------------|---------------------|---------------------|---------------------|-----------------------|---------------------|------------|
| BUDGET ACTIVITY<br>3 - Advanced Technology Development  |   |                   |                     | PE NUMBER AND TITLE<br>0603001A Logistics Advanced Technology |                     |                     |                     |                     |                       |                     |            |
| COST (In Thousands)   |   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate   | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate   | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost   |   | 38820             | 22724               | 35469   | 32197               | 32122               | 14544               | 16134               | 14676                 | Continuing          | Continuing |
| DC07  | Joint Service Food Technology Demonstration | 1846              | 1851                | 1940  | 1987                | 2027                | 2066                | 2106                | 2152                  | Continuing          | Continuing |
| DC44  | Tactical Logistics                          | 755               | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                     | 0                   | 755        |
| DJ28  | Test Measurement Technology Development     | 0                 | 246                 | 0   | 0                   | 0                   | 0                   | 0                   | 0                     | 0                   | 246        |
| DJ50  | Force XXI Land Warrior                      | 30548             | 15936               | 11298   | 7016                | 6423                | 6434                | 7669                | 7997                  | Continuing          | Continuing |
| D242  | Airdrop Equipment                           | 1240              | 1223                | 1258  | 1273                | 1919                | 3216                | 3522                | 3672                  | Continuing          | Continuing |
| D393  | Military Operations in Urban Terrain        | 0                 | 0                   | 20255   | 21124               | 20942               | 2002                | 1997                | 0                     | 0                   | 66320      |
| D543  | Ammunition Logistics                        | 3155              | 3032                | 718   | 797                 | 811                 | 826                 | 840                 | 855                   | Continuing          | Continuing |
| D544  | Cooperative Explosive Safety                | 950               | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                     | 0                   | 950        |
| D594  | Metrology and Calibration                   | 326               | 436                 | 0   | 0                   | 0                   | 0                   | 0                   | 0                     | 0                   | 762        |
| <p><b>Mission Description and Budget Item Justification:</b> 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 enhance dismounted soldier system performance and capabilities, reduce the logistics burden on the battlefield, reduce operation and support (O&amp;S) costs, and improve ammunition logistics system performance. It includes diverse projects linked by broad applications benefiting whole categories of weapons systems and providing high return on investment. The Joint Service Food Technology project demonstrates food service systems and food products, processing, preservation, and serving equipment resulting from technology programs jointly approved by the Services and the Defense Logistics Agency that will improve field feeding efficiencies, ration quality, and warfighter combat effectiveness. The Tactical Logistics project demonstrated applications of technology for tactical electric power. Force XXI Land Warrior develops and demonstrates advanced technology components for insertion into the Land Warrior program and performs the integration of future soldier system technologies focused on improving soldier performance, lethality and survivability. Enhancements to airdrop equipment for rapid deployment are required for dropping cargo 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 Military Operations in Urban Terrain (MOUT) ACTD will identify, integrate, and demonstrate a system of existing and emerging technologies to provide</p> |   |                   |                     |   |                     |                     |                     |                     |                       |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                              |
| <p>improved Command, Control, Communications, and Intelligence (C4I), engagement, and force protection for Soldiers and Marines operating in the restrictive urban environment.</p> <p>The Ammunition Logistics project demonstrates technology that optimizes weapon system rearm, ammunition packaging/palletization, explosives safety, material handling equipment, ammunition throughput/management for improved asset availability and survivability. Contractors performing the work for this PE include Motorola, Hughes, Honeywell, Gentex, Battelle, Arthur D. Little, Tecogen, Pioneer Aerospace, Giordano Automation, and InterVision. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan. This program adheres to Tri-Service Reliance Agreements on clothing, textiles and food and explosive ordnance disposal with oversight and coordination provided by the Joint Directors of Laboratories. Work in this program element is related to and fully coordinated with efforts in PE 0602786A (Logistics Technology), Navy's integrated diagnostic support system, Missile Command Infrared (IR) scene generation, Defense Advanced Research Project Agency (DARPA) millimeter/microwave integrated circuit (MMIC), Small Unit Operations projects, 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.</p> |  |                              |



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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                |                  |                    |  |                  |                  |                           | DATE<br><b>February 1997</b> |                  |            |
|---|----------------|------------------|--------------------|--|------------------|------------------|---------------------------|------------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                |                  |                    | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                  |                  |                           | PROJECT<br><b>DC07</b>       |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate             | Cost to Complete | Total Cost |
| DC07 Joint Service Food Technology Demonstration  | 1846           | 1851             | 1940               | 1987   | 2027             | 2066             | 2106                      | 2152                         | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> Joint Service Food is a DoD program, for which the Army has executive agent responsibility, which demonstrates nutritionally advanced rations and logistically streamlined food delivery systems to sustain DoD personnel in all operations and to enhance their combat performance under diverse battlefield scenarios. The project focuses on demonstrations of advances in food technology, materials, energy utilization, and combination heating technologies to provide extended, simplified field feeding without resupply. It exploits advances in ration formulation and quality, packaging, preservation, and nutritional content to improve morale, extend endurance, and sharpen mental acuity. This project is managed by the U.S. Army Natick Research, Development, and Engineering Center, Natick, MA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 624 - Demonstrated promising technologies (including aseptic processing, horizontal form/fill/seal and high barrier polymeric tray) for potential technology insertion to expand combat ration variety, improve acceptability, nutrient retention, producibility and reduce costs.               <ul style="list-style-type: none"> <li>- Demonstrated, under realistic field conditions, prototype high heat stable ration components; demonstrated the impact of nutrient content modifications and/or supplements to rations in hot weather feeding scenarios (43% increase in carbohydrate intake and 22% decrease in fat consumed).</li> <li>- Initiated a demonstration of the eat-on-the-move characteristics of Mobility Enhancing Ration improvements which exploit advances in food processing technologies and in ration packaging.</li> </ul> </li> <li>• 1222 - Conducted technical demonstrations of a centrally heated thermal fluid heat transfer system in a small mobile kitchen validating rapid deployability, 70% efficiency, high reliability, ease of operation, multi-ration flexibility, and the ability to produce more meals faster and cheaper than conventional systems; transitioned to advanced development; designed and fabricated Thermal-Powered Washer for demonstration of improved field sanitation capability.</li> </ul> <p>Total 1846</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 982 - Conduct demonstration of the Mobility Enhancing Ration Components, which incorporate advances in packaging technologies (i.e., horizontal form/fill/seal), increasing the operational capabilities of warfighters.               <ul style="list-style-type: none"> <li>- Demonstrate improved rations/consumption which will result in a 15-20 percent increase in nutrient bioavailability of calcium and iron in high temperature environments and transition to Defense Logistics Agency (DLA).</li> <li>- Conduct demonstrations of selected performance enhancing nutrients and food components (i.e. carbohydrate beverages, caffeine, tyrosine).</li> <li>- Obtain Services' approval of selected Performance Enhancing Ration Components (PERCs) and transition to DLA.</li> <li>- Demonstrate producibility and microbial safety of a shelf stable/fresh-like ration based on multiple barrier processing of marine products to expand the variety of ration meals.</li> </ul> </li> </ul> <p><b>FY 1997 Planned Program: (continued)</b></p> |                |                  |                    |  |                  |                  |                           |                              |                  |            |
| Project DC07  |                |                  | Page 3 of 18 Pages |  |                  |                  | Exhibit R-2 (PE 0603001A) |                              |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b>                  |                |                |                |
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| BUDGET ACTIVITY  |  | PE NUMBER AND TITLE                           |                | PROJECT        |                |
| <b>3 - Advanced Technology Development</b>                     |  | <b>0603001A Logistics Advanced Technology</b> |                | <b>DC07</b>    |                |
| •  | 823 - Demonstrate a Thermal-Powered Washer in the Food Sanitation Center that reduces water and fuel consumption by 50%, while providing more effective sanitation; design and fabricate an adsorption type heat driven refrigerator for technical demonstrations in mobile field kitchens to enhance A-Ration capability.   |   |                |                |                |
| •  | 46 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |   |                |                |                |
| Total  | 1851   |   |                |                |                |
| <b>FY 1998 Planned Program:</b>                                |  |   |                |                |                |
| •  | 983 - Complete technology demonstration of Mobility Enhancing Ration Components and transition to DLA; conduct technology demonstration of multi barrier processing of marine ration components and transition to DLA; conduct technology demonstration of Performance Enhancing Ration Components and transition to Fielded Individual Ration Improvement Program (FIRIP).<br>- Develop algorithm to model effects of performance-enhancing nutrients on warfighter mission performance.  |   |                |                |                |
| •  | 957 - Demonstrate an adsorption type heat driven refrigerator that will keep food cold for one to three days, and that can be regenerated with a standard field burner; transition to advanced development; design and fabricate a diesel to gas reformer that can provide a natural-gas-like fuel for commercial gas cooking appliances for technical demonstrations in mobile field kitchens; complete test and evaluation of future shipboard galley concept incorporating new food service equipment technologies.   |   |                |                |                |
| Total  | 1940   |   |                |                |                |
| <b>FY 1999 Planned Program:</b>                                |  |   |                |                |                |
| •  | 1987 - Complete demonstration of a field feeding system based on recent advances in catalytic diesel combustion, thermal fluid heat transfer, integral power generation and regenerative refrigeration that is highly mobile (HMWWV towable), rapidly deployable (minutes), more efficient (50% decrease in fuel), more reliable (50% increase in mean-time between failure (MTBF)), and that expands the tactical situations (by 40%) in which hot meals can be prepared and delivered.<br>- Demonstrate producibility of interactive packaging technologies and quantify the effects of interactive packaging on improving ration acceptance and consumption; transition to DLA.<br>- Demonstrate the effects of incremental differences in carbohydrates on mission effectiveness and completion. |   |                |                |                |
| Total  | 1987   |   |                |                |                |
| <b>B. Project Change Summary</b>                               |  | <u>FY 1996</u>                                | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget                                     |  | 1893  | 1891           | 1895           | 2003           |
| Appropriated Value   |  | 1946  | 1851           |                |                |
| Adjustments to Appropriated Value                              |  | -100  |                |                |                |
| FY1998 Pres Bud Request  |  | 1846  | 1851           | 1940           | 1987           |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|-----|---|---|---|--------------------|-----|---|--|--|-----------------------------------|-----|--|--|--|-------------------------|-----|---|---|---|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                     |                     |                     | PROJECT<br><b>DC44</b>       |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| DC44 Tactical Logistics  | 755               | 0                   | 0                   | 0  | 0                   | 0                   | 0                   | 0                            | 0                   | 755        |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| <p><b>A. Mission Description and Justification:</b> This project developed technology and materials to improve tactical electrical power availability for all DoD systems. Efforts were directed toward drastically decreasing the size, weight, and number of engines, generators and auxiliary power units needed to power the battlefield. Programs specifically supported include Soldier Individual Power, the Joint Project Office for Unmanned Aerial Vehicles, and Special Operations Forces programs. This project was managed by the U.S. Army Communications-Electronics Command, Ft. Monmouth, NJ.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 755 - Completed power requirements analysis for dismounted soldier systems. Conducted and completed battery study to meet dismounted soldier system requirements.</li> </ul> <p>Total 755</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border: none;"> <thead> <tr> <th></th> <th style="text-align: right;"><u>FY 1996</u></th> <th style="text-align: right;"><u>FY 1997</u></th> <th style="text-align: right;"><u>FY 1998</u></th> <th style="text-align: right;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">775</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">796</td> <td align="right">0</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-41</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td align="right">755</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> |                   |                     |                     |  |                     |                     |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 775 | 0 | 0 | 0 | Appropriated Value | 796 | 0 |  |  | Adjustments to Appropriated Value | -41 |  |  |  | FY1998 Pres Bud Request | 755 | 0 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| FY 1997 President's Budget   | 775               | 0                   | 0                   | 0  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| Appropriated Value   | 796               | 0                   |                     |  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| Adjustments to Appropriated Value  | -41               |                     |                     |  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| FY1998 Pres Bud Request  | 755               | 0                   | 0                   | 0  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603001A Logistics Advanced Technology</b> |                     |                           |                     | <b>PROJECT</b><br><b>DJ28</b> |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| DJ28 Test Measurement Technology Development  | 0                 | 246                 | 0                   | 0   | 0                   | 0                         | 0                   | 0                             | 0                   | 246        |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| <p><b>A. Mission Description Justification:</b> 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 make 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. Older systems will be maintained by a wearable, hands-free, intelligent maintenance aid now under development. This project is managed by the U.S. Army Test, Measurement, and Diagnostic Equipment Activity, Redstone Arsenal, AL.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 240 - Enhance Apache prototype electronics manuals with maintenance and repair support system (MARSS) wearable maintenance aid and advanced diagnostics.</li> <li>• 6 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR).</li> </ul> <p>Total 246</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border: none;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1996</u></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">251</td> <td style="text-align: center;">400</td> <td style="text-align: center;">576</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">0</td> <td style="text-align: center;">246</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">0</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">246</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1998/1999 - Funds reprogrammed to higher priority requirements.</p> |                   |                     |                     |   |                     |                           |                     |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 251 | 400 | 576 | Appropriated Value | 0 | 246 |  |  | Adjustments to Appropriated Value | 0 |  |  |  | FY1998 Pres Bud Request | 0 | 246 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| FY 1997 President's Budget  | 0                 | 251                 | 400                 | 576   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| Appropriated Value  | 0                 | 246                 |                     |   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| Adjustments to Appropriated Value   | 0                 |                     |                     |   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| FY1998 Pres Bud Request   | 0                 | 246                 | 0                   | 0   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |
| Project DJ28  |                   |                     | Page 6 of 18 Pages  |   |                     | Exhibit R-2 (PE 0603001A) |                     |                               |                     |            |  |                |                |                |                |                            |   |     |     |     |                    |   |     |  |  |                                   |   |  |  |  |                         |   |     |   |   |

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| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                        |                    |                  | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                  |                           |                  |                  | PROJECT<br><b>DJ50</b>       |                  |            |
| COST (In Thousands)  |                        | FY 1996 Actual     | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate | FY 2000 Estimate          | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate             | Cost to Complete | Total Cost |
| DJ50   | Force XXI Land Warrior | 30548              | 15936            | 11298  | 7016             | 6423                      | 6434             | 7669             | 7997                         | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project was created as the result of FY 1996 Congressional direction to consolidate the Generation II Soldier and the Land Warrior (LW) Programs and addresses the critical Army need to enhance the performance, lethality, survivability, and sustainment of the individual soldier. This project is the Land Warrior science and technology (S&amp;T) program. The Force XXI Land Warrior efforts will focus on technology insertions to the LW backbone and perform risk reduction tasks aimed at providing to the LW program appropriate technologies which will enhance the LW system or provide improved capabilities such as Reduced Weight Helmet, Helmet Mounted Display, Digital Radio, Voice Activated Soldier Radio and Radio Packet Relay. An early user test (EUT) will be performed during late FY 1998 and early FY99 with modified LW systems to assess the performance of the science and technology (S&amp;T) components. These results will be utilized to further reduce LW fielding risks and to ensure that future LW procurements are upgraded with current technological advancements. Another Force XXI Land Warrior component which will form a part of this effort is Integrated Sight which involves a lighter uncooled IR rifle sight with integrated target handover functions. Other emerging technology base components will also be considered as candidates for technology insertion onto the LW platform through these efforts. These components include combat identification, personnel status monitor, future infantry weapons, mine detection, chemical agent detector, and others. This program will leverage the commercial microelectronics and telecommunications industries to achieve lightweight, miniaturized components. The U.S. Marine Corps is an active participant in this program. In FY 1996, a significant portion of the total program funding was used to perform work within Budget Activity 5 (Engineering and Manufacturing Development (EMD)) in accordance with the FY 1996 Appropriations language which consolidated the funding for both S&amp;T and non-S&amp;T into a single project. In FY 1997, the EMD work was separated into the appropriate Budget Activity within PE 0604713A (Night Vision Systems - EMD). This project is managed by the U.S. Army Soldier Systems Command, Natick, MA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 10473 - Completed Phase II (bread board components) of the Generation II Soldier ATD. <ul style="list-style-type: none"> <li>- Initiated risk reduction designs/virtual prototyping (e.g. helmet to reduce weight) and began development of advanced components (e.g. radio packet relay and integrated sight) in support of the Land Warrior Program.</li> <li>- Completed technology insertion plans for Land Warrior upgrades.</li> </ul> </li> <li>• 20075 - Initiated LW EMD program and established Integrated Product Teams. <ul style="list-style-type: none"> <li>- Completed LW EMD preliminary design review (PDR) and critical design review (CDR) for early operational experimentation (EOE) systems and software design review (SDR) for pre-production qualification test (PPQT) systems.</li> <li>- Performed iterative development along with User feedback, to reduce risk while developing a system that meets User's requirement for EOE.</li> <li>- Procured prototype components of integrated helmet with speakers and day/night displays, digital radio, laser rangefinder digital compass, and image intensifier for squad size early operational experimentation (EOE).</li> <li>- Performed LW EMD program management: scheduling, program controls, program documentation, and review of performance, cost and schedule; reviewed LW EMD contractor's performance, to include system analysis, and logistics support.</li> </ul> </li> </ul> <p>Total 30548</p> |                        |                    |                  |  |                  |                           |                  |                  |                              |                  |            |
| Project DJ50   |                        | Page 7 of 18 Pages |                  |  |                  | Exhibit R-2 (PE 0603001A) |                  |                  |                              |                  |            |

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| BUDGET ACTIVITY  | PE NUMBER AND TITLE   | PROJECT                      |
| <b>3 - Advanced Technology Development</b>                     | <b>0603001A Logistics Advanced Technology</b>   | <b>DJ50</b>                  |
| <b>FY 1997 Planned Program:</b>                                |   |                              |
| • 15547  | - Complete risk reduction designs/virtual prototyping in support of Land Warrior.<br>- Develop and fabricate advanced technology components for insertion into Land Warrior Systems in preparation for the early user test.<br>- Procure long lead items for additional Land Warrior systems to be used in evaluating advanced technology components.<br>- Identify and initiate development of component enhancements based on the results of Early Operational Experimentation. |                              |
| • 389  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                              |
| Total 15936  |   |                              |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| • 5050   | - Continue development of the Integrated Sight; deliver 9 short range and 3 long range sights.<br>- Continue development of evolutionary technology insertion components for the Land Warrior.<br>- Continue development of revolutionary technology insertion components for the Land Warrior system.  |                              |
| • 6248   | - Procure Land Warrior pre-production qualification test (PPQT) systems.<br>- Integrate evolutionary components into Land Warrior PPQT systems.<br>- Perform baseline early user test with PPQT systems.<br>- Perform early user test with upgraded PPQT systems.   |                              |
| Total 11298  |   |                              |
| <b>FY 1999 Planned Program:</b>                                |   |                              |
| • 5500   | - Continue development of revolutionary technology insertions for the Land Warrior.<br>- Complete early user testing of upgraded PPQT systems.<br>- Perform a cost and operational effectiveness analysis on evolutionary components.<br>- Prepare transition documents for transitioning of evolutionary components to the Land Warrior system.<br>- Integrate revolutionary components into upgraded PPQT systems.  |                              |
| • 1516   | - Develop Military Operations in Urban Terrain (MOUT) technology insertion components.<br>- Integrate MOUT capabilities into upgraded PPQT systems.   |                              |
| Total 7016   |   |                              |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|------|------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|-------------------------|-------|-------|-------|------|--|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603001A Logistics Advanced Technology</b>  | <b>PROJECT</b><br><b>DJ50</b> |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
| <b>B. <u>Project Change Summary</u></b>   | <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 15%; text-align: center;"><u>FY 1996</u></th> <th style="width: 15%; text-align: center;"><u>FY 1997</u></th> <th style="width: 15%; text-align: center;"><u>FY 1998</u></th> <th style="width: 15%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">29181</td> <td style="text-align: center;">16277</td> <td style="text-align: center;">6324</td> <td style="text-align: center;">2410</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">30000</td> <td style="text-align: center;">15936</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+548</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">30548</td> <td style="text-align: center;">15936</td> <td style="text-align: center;">11298</td> <td style="text-align: center;">7016</td> </tr> </tbody> </table> |                               | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 29181 | 16277 | 6324 | 2410 | Appropriated Value | 30000 | 15936 |  |  | Adjustments to Appropriated Value | +548 |  |  |  | FY1998 Pres Bud Request | 30548 | 15936 | 11298 | 7016 |  |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
| FY 1997 President's Budget  | 29181  | 16277                         | 6324           | 2410           |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
| Appropriated Value  | 30000  | 15936                         |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
| Adjustments to Appropriated Value   | +548   |                               |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
| FY1998 Pres Bud Request   | 30548  | 15936                         | 11298          | 7016           |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
| <p>Change Summary Explanation: Funding: FY 1998/1999 - Funds increased to perform EUT with greater number of technologies and to enable the transition of the insertions to LW.</p> |  |                               |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
|   |  |                               |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |
| Project DJ50  | Page 9 of 18 Pages   | Exhibit R-2 (PE 0603001A)     |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |      |  |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                   |                |                  |  |                  |                  |                           | DATE<br><b>February 1997</b> |                  |                  |            |
|---|-------------------|----------------|------------------|--|------------------|------------------|---------------------------|------------------------------|------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                |                  | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                  |                  |                           | PROJECT<br><b>D242</b>       |                  |                  |            |
| COST (In Thousands)   |                   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate          | FY 2002 Estimate             | FY 2003 Estimate | Cost to Complete | Total Cost |
| D242  | Airdrop Equipment | 1240           | 1223             | 1258   | 1273             | 1919             | 3216                      | 3522                         | 3672             | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project focuses on the demonstration and development of innovative techniques and equipment for aerial delivery of cargo, a key capability for rapid force projection, particularly into hostile areas. 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 1997 is the initiation of the design and fabrication of an advanced airdrop system which will lead to the demonstration of revolutionary technologies for the reliable precision guided delivery of combat essential munitions/sensors and equipment using high glide wing technology and incorporating a low cost, modular global positioning system (GPS) guidance package and control system.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1240 - Continued testing of 15,000 pound capacity prototype parafoil system autonomous GPS guidance, navigation and control (GN&amp;C) and soft landing capability (GPADS - Medium).</li> <li>- Conducted Advanced Technology Demonstration (ATD) of complete 15,000 lb. capacity parafoil system.</li> <li>- Defined concepts for High Glide Air Delivery (HGAD) system with 5000 lb. payload capacity (goal of 10,000 lbs.) and 6:1 glide ratio.</li> </ul> <p>Total 1240</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1193 - Design and begin fabrication of High Glide Air Delivery system prototype using high glide wing technology.</li> <li>- Integrate guidance, navigation and control system with high glide wing technology.</li> <li>• 30 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1223</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1258 - Complete fabrication of High Glide Air Delivery prototypes.</li> <li>- Conduct extraction test from USAF aircraft.</li> </ul> <p>Total 1258</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1273 - Conduct flight testing of High Glide Air Delivery system.</li> <li>- Conduct demonstration of High Glide Air Delivery System.</li> </ul> <p>Total 1273</p> |                   |                |                  |  |                  |                  |                           |                              |                  |                  |            |
| <b>B. Project Change Summary</b>  |                   |                |                  | FY 1996  | FY 1997          | FY 1998          | FY 1999                   |                              |                  |                  |            |
| Project D242  |                   |                |                  | Page 10 of 18 Pages  |                  |                  | Exhibit R-2 (PE 0603001A) |                              |                  |                  |            |



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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603001A Logistics Advanced Technology</b> | <b>PROJECT</b><br><b>D242</b> |
|--|---|-------------------------------|

| <b>B. Project Change Summary</b>  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 1272           | 1249           | 1247           | 1260           |
| Appropriated Value                | 1307           | 1223           |                |                |
| Adjustments to Appropriated Value | -67            |                |                |                |
| FY1998 Pres Bud Request           | 1240           | 1223           | 1258           | 1273           |

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|--|--------------------------------------|---------------------|------------------|--|------------------|---------------------------|------------------|------------------------------|------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                                      |                     |                  | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                  |                           |                  | PROJECT<br><b>D393</b>       |                  |                  |            |
| COST (In Thousands)  |                                      | FY 1996 Actual      | FY 1997 Estimate | FY 1998 Estimate   | FY 1999 Estimate | FY 2000 Estimate          | FY 2001 Estimate | FY 2002 Estimate             | FY 2003 Estimate | Cost to Complete | Total Cost |
| D393   | Military Operations in Urban Terrain | 0                   | 0                | 20255  | 21124            | 20942                     | 2002             | 1997                         | 0                | 0                | 66320      |
| <p><b>A. Mission Description and Justification:</b> This project conducts the integration of a system of systems and conducts a series of live demonstrations and simulations to identify technology and assess operational solutions for enhancing military operations in urban terrain. In FY 1998, the Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstration (ACTD) will be initiated by integrating the products of promising technology developments underway in the Army, Marine Corps, DARPA, creating the MOUT System of Systems. The objective is to improve the command, control, communications, computers, and intelligence (C4I), survivability, and engagement capabilities of the soldiers and Marines, and ensure the effective interoperability of these capabilities in the particularly challenging urban environment. The program vision is to set the stage for the rapid and efficient acquisition and fielding of value-added components in the MOUT System of Systems following the completion of the ACTD. A company set of residuals for an interim leave-behind capability will be procured during FY 1998/1999; the full spectrum residuals will be procured FY 2000. Follow-on support to the receiving operational unit will be conducted during FY 2001/2002. The MOUT ACTD is a joint ACTD between the Army and the Marine Corps, with participation from DARPA. This project is managed by U.S. Army Natick Research, Development, and Engineering Center, Natick, MA.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 11031 - Award engineering services contract to conduct the integration/interoperability assessments/diagnoses of Army/USMC/DARPA technology products. <ul style="list-style-type: none"> <li>- Conduct simulations and exercise models to assess/quantify military value-added of MOUT components.</li> </ul> </li> <li>• 9224 - Procure prototype/residual hardware/software for use in MOUT experiments. <ul style="list-style-type: none"> <li>- Conduct initial MOUT demonstrations/experiments at Fort Benning and Camp Lejeune.</li> <li>- Conduct planning/management/coordination/execution of MOUT ACTD program.</li> </ul> </li> </ul> <p>Total 20255</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9864 - Conduct engineering services for the integration/interoperability assessments/diagnoses of Army/USMC/DARPA technology products in MOUT. <ul style="list-style-type: none"> <li>- Continue to conduct simulations and exercise models to assess/quantify military value-added of MOUT components; assess MOUT Training, Tactics and Procedures (TTPs).</li> </ul> </li> </ul> <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 11260 - Continue to procure prototype/residual hardware/software for use in MOUT experiments.</li> </ul> |                                      |                     |                  |  |                  |                           |                  |                              |                  |                  |            |
| Project D393   |                                      | Page 12 of 18 Pages |                  |  |                  | Exhibit R-2 (PE 0603001A) |                  |                              |                  |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b> |                               |                |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603001A Logistics Advanced Technology</b> |                              | <b>PROJECT</b><br><b>D393</b> |                |
| <p style="margin-left: 40px;">- Conduct follow-on MOUT demonstrations/experiments at Fort Benning and Camp Lejeune.<br/>- Continue to conduct planning/management/coordination/execution of MOUT ACTD program.</p> <p>Total            21124</p> |   |                              |                               |                |
| <b>B. Project Change Summary</b>   |   |                              |                               |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u>                | <u>FY 1999</u> |
| FY 1997 President's Budget   | 0   | 0                            | 20311                         | 21199          |
| Appropriated Value   |   |                              |                               |                |
| Adjustments to Appropriated Value  |   |                              |                               |                |
| FY1998 Pres Bud Request  | 0   | 0                            | 20255                         | 21124          |
|  |   |                              |                               |                |
| Project D393   | Page 13 of 18 Pages   | Exhibit R-2 (PE 0603001A)    |                               |                |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                |                  |                     |  |                  |                  |                           | DATE<br><b>February 1997</b> |                  |            |
|---|----------------|------------------|---------------------|--|------------------|------------------|---------------------------|------------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                |                  |                     | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                  |                  |                           | PROJECT<br><b>D543</b>       |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate    | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate             | Cost to Complete | Total Cost |
| D543 Ammunition Logistics   | 3155           | 3032             | 718                 | 797  | 811              | 826              | 840                       | 855                          | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project develops technology that maximizes munitions availability and survivability for the force projection Army. It enhances logistics survivability and force readiness through improvements in explosive safety, materiel handling equipment, ammunition and missile packaging/palletization, and asset throughput/management. It also improves weapon system rearm for artillery, armor, air defense, aviation, and infantry. Emerging technologies and productivity enhancers/cost savers are exploited to provide quantum improvements to the force projection (strategic), in-theater (operational), and combat-focused (tactical) logistics systems. This project is managed by the U.S. Army Armament Research, Development, and Engineering Center, Picatinny Arsenal, NJ. Efforts will transition to weapons and munitions technology/development programs and the Total Army Distribution System.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1848 - Demonstrated advanced munitions packaging technologies in the following areas: advanced materials, adhesives and bonding, vibration damping, cushioning, and "smart" sensors that monitor and record environmental data (temperature, humidity, pressure, shock, corrosion) throughout the logistics cycle. <ul style="list-style-type: none"> <li>- Demonstrated a fire extinguishing system for ammunition plants/depots that utilizes advanced fire detection sensor and suppression technology to reduce system response time by 75%.</li> <li>- Upgraded FASTLOAD (artillery rearm module on HEMMT) with digital interface to allow external transfer of inventory and requirements data.</li> </ul> </li> <li>• 1307 - Completed demonstration of prototype insensitive munitions (IM) packaging and transitioned to item developers. <ul style="list-style-type: none"> <li>- Developed concepts/investigated modeling and simulation in support of the Munitions Survivability program.</li> </ul> </li> </ul> <p>Total 3155</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1914 - Demonstrate prototype handling equipment enhancements for improved munitions velocity management. <ul style="list-style-type: none"> <li>- Develop prototype decision aid software to help soldiers design survivable forward area ammunition storage sites.</li> <li>- Complete design concepts of barriers, shields, and packaging to prevent explosive incompatibilities and maximize the survivability of munitions strategic configured loads.</li> </ul> </li> <li>• 1051 - Select and initiate testing of lightweight, fire retardant and shock absorbing material candidates for a rapid ammunition protection system to limit loss at a forward ammunition storage area to only 1% of assets from a direct hit and also reduce ammunition storage area footprint by 60%. <ul style="list-style-type: none"> <li>- Develop heat transport computer codes and hydrocode sympathetic detonation models for treating shocks, rapid compression, and penetration in porous rapid ammo protection system material candidates.</li> <li>- Complete upgrade and conduct demonstration of FASTLOAD automated rearm system for towed and self-propelled howitzers.</li> </ul> </li> </ul> |                |                  |                     |  |                  |                  |                           |                              |                  |            |
| Project D543  |                |                  | Page 14 of 18 Pages |  |                  |                  | Exhibit R-2 (PE 0603001A) |                              |                  |            |

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|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|-------------------------|------|------|-----|-----|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603001A Logistics Advanced Technology</b> | <b>PROJECT</b><br><b>D543</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |     |     |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 67 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3032</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 718 - Calibrate sympathetic detonation computational models to define specifications for a rapid ammunition protection system which prevents fire propagation and achieves optimum shock attenuating performance.</li> </ul> <p>Total 718</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 797 - Conduct full scale experiments to verify sympathetic detonation computational models to demonstrate a rapid ammo protection system utilizing lightweight, high performance materials and designs optimized to prevent fire propagation and mitigate explosive propagation.</li> </ul> <p>Total 797</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">3228</td> <td style="text-align: center;">3097</td> <td style="text-align: center;">3000</td> <td style="text-align: center;">4697</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3318</td> <td style="text-align: center;">3032</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-163</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">3155</td> <td style="text-align: center;">3032</td> <td style="text-align: center;">718</td> <td style="text-align: center;">797</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1998/1999 - Funds reprogrammed to higher priority requirements.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 3228 | 3097 | 3000 | 4697 | Appropriated Value | 3318 | 3032 |  |  | Adjustments to Appropriated Value | -163 |  |  |  | FY1998 Pres Bud Request | 3155 | 3032 | 718 | 797 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |     |     |
| FY 1997 President's Budget  | 3228  | 3097                          | 3000           | 4697           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |     |     |
| Appropriated Value  | 3318  | 3032                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |     |     |
| Adjustments to Appropriated Value   | -163  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |     |     |
| FY1998 Pres Bud Request   | 3155  | 3032                          | 718            | 797            |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |     |     |
| Project D543  | Page 15 of 18 Pages   | Exhibit R-2 (PE 0603001A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |     |     |

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|---|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|-----|---|---|---|--------------------|-----|---|--|--|-----------------------------------|-----|--|--|--|-------------------------|-----|---|---|---|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603001A Logistics Advanced Technology</b> |                     |                           |                     | PROJECT<br><b>D544</b>       |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| D544 Cooperative Explosive Safety   | 950               | 0                   | 0                   | 0  | 0                   | 0                         | 0                   | 0                            | 0                   | 950        |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| <p><b>A. Mission Description and Justification:</b> This was a cooperative program with the Republic of Korea (ROK). Efforts were devoted to improving ammunition explosives safety through technology solutions. The effort focused on the development, testing, and validation of new underground explosives storage techniques to 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 program concluded in December 1996 as specified in the Joint U.S./ROK Memorandum of Agreement. No FY 1997 funds were programmed or required to complete the program. This project was managed by the U.S. Army Technical Center for Explosives Safety, Savanna, IL.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 950 - Conducted validation test and evaluated test data.</li> <li style="padding-left: 20px;">- Integrated test data and logistics considerations into operational full-scale underground facility concept.</li> <li style="padding-left: 20px;">- Developed and completed technical designs and data packages of full-scale facilities for underground ammunition storage.</li> </ul> <p>Total 950</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border: none;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">969</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">995</td> <td align="right">0</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-45</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td align="right">950</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 969 | 0 | 0 | 0 | Appropriated Value | 995 | 0 |  |  | Adjustments to Appropriated Value | -45 |  |  |  | FY1998 Pres Bud Request | 950 | 0 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| FY 1997 President's Budget  | 969               | 0                   | 0                   | 0  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| Appropriated Value  | 995               | 0                   |                     |  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| Adjustments to Appropriated Value   | -45               |                     |                     |  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| FY1998 Pres Bud Request   | 950               | 0                   | 0                   | 0  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |
| Project D544  |                   | Page 16 of 18 Pages |                     |  |                     | Exhibit R-2 (PE 0603001A) |                     |                              |                     |            |  |                |                |                |                |                            |     |   |   |   |                    |     |   |  |  |                                   |     |  |  |  |                         |     |   |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                            |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0603001A Logistics Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D594</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D594 Metrology and Calibration   | 326               | 436                 | 0                          | 0   | 0                   | 0                   | 0                         | 0                             | 0                   | 762        |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides Army weapon systems and technology developers with cost effective, time saving, legally mandated, traceable calibration equipment for microwave, electro-optics, mechanical, and electronic 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 (HPCOR). 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 326 - Completed technology development for Fourier Transform Infrared non-linearity effects.</li> <li style="padding-left: 20px;">- Began development of intrinsic voltage for alternating current Josephson Junction effect.</li> <li style="padding-left: 20px;">- Field-tested closed-cycle refrigerated Josephson Junction intrinsic voltage standard.</li> </ul> <p>Total 326</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 425 - Develop wireless access of weapon system test data for remote analysis.</li> <li style="padding-left: 20px;">- Develop prototype lightweight glasses for displaying test data.</li> <li>• 11 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 436</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> |                   |                     |                            |   |                     |                     |                           |                               |                     |            |
| Project D594   |                   |                     | <i>Page 17 of 18 Pages</i> |   |                     |                     | Exhibit R-2 (PE 0603001A) |                               |                     |            |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>                                    | <b>PE NUMBER AND TITLE</b><br><b>0603001A Logistics Advanced Technology</b> |                           |                | <b>PROJECT</b><br><b>D594</b> |
| <b>B. <u>Project Change Summary</u></b>   | <u>FY 1996</u>  | <u>FY 1997</u>            | <u>FY 1998</u> | <u>FY 1999</u>                |
| FY 1997 President's Budget  | 336   | 445                       | 564            | 672                           |
| Appropriated Value  | 345   | 436                       |                |                               |
| Adjustments to Appropriated Value   | -19   |                           |                |                               |
| FY1998 Pres Bud Request   | 326   | 436                       | 0              | 0                             |
| Change Summary Explanation: Funding: FY 1998/1999 - Funds reprogrammed to higher priority requirements. |   |                           |                |                               |
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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>                             |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> |                     |                     |                     |                     |                              |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete          | Total Cost |
| Total Program Element (PE) Cost  | 90591             | 201198              | 10677               | 10959   | 10691               | 10826               | 11986               | 12543               | Continuing                   | Continuing |
| D804 Prostate Cancer Research  | 0                 | 44058               | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 44058      |
| D806 Breast Cancer Research  | 71119             | 97906               | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 169025     |
| D810 Industrial Base/Infectious Disease Vaccines and Drugs                                       | 8888              | 9034                | 8274                | 8504  | 8018                | 8129                | 8674                | 9096                | Continuing                   | Continuing |
| D813 Trichloromelamine Testing   | 0                 | 490                 | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 490        |
| D814 Neurofibromatosis   | 0                 | 7832                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 7832       |
| D815 National Medical Testbed  | 0                 | 5874                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 5874       |
| D816 Computer-Based Decision Support System  | 0                 | 5874                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 5874       |
| D817 Computer-Aided Diagnostic Research  | 0                 | 2937                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 2937       |
| D818 Advanced Cancer Detection Center  | 0                 | 3427                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 3427       |
| D819 Field Medical Protection and Human Performance Enhancement-Non-Systems Advanced Development | 1683              | 2350                | 0                   | 0   | 207                 | 202                 | 581                 | 602                 | Continuing                   | Continuing |
| D840 Combat Injury Management  | 2264              | 2324                | 2403                | 2455  | 2466                | 2495                | 2731                | 2845                | Continuing                   | Continuing |
| D887 Ovarian Cancer Research   | 0                 | 7343                | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 7343       |
| D892 Blood Analyzer  | 1897              | 0                   | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 1897       |
| D893 Tissue Replacement  | 4740              | 11749               | 0                   | 0   | 0                   | 0                   | 0                   | 0                   | 0                            | 16489      |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> |                              |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> This program element funds advanced technology development for the DoD core Vaccine and Drug Program, 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 military disease threats. Pilot and standard lots of candidate pharmaceutical-grade drugs, antidotes and vaccines are produced. The primary goal of this program is to provide, with minimum adverse effects, maximum soldier survivability and sustainability on the integrated battlefield as well as in military operations other than war. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. This program is managed primarily by the US Army Medical Research and Materiel Command. This program is dedicated to conducting proof of principle field demonstrations and tests of non-system-specific technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.</p> |   |                              |
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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D804</b> |
|--|---|-------------------------------|

| COST (In Thousands)           | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|-------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D804 Prostate Cancer Research | 0              | 44058            | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 44058      |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to develop initial research models for prostate cancer research to include studying prostate cancer diagnosis and treatment in cooperation with the Center for Prostate Disease Research.

**FY 1996 Accomplishments:** Program not funded in FY 96.

**FY 1997 Planned Program:**

- 42981 Evaluate and award competitive contracts/grants to initiate research on prostate cancer.
  - 1077 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 44058

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 0              | 0              | 0              | 0              |
| Appropriated Value                | 0              | 44058          |                |                |
| Adjustments to Appropriated Value |                |                |                |                |
| FY 1998 Pres Bud Request          | 0              | 44058          | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+44058) provided by Congressional action.

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| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b> | PROJECT<br><b>D806</b> |
|---|--|------------------------|

| COST (In Thousands)         | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|-----------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D806 Breast Cancer Research | 71119          | 97906            | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 169025     |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to continue the peer-reviewed Breast Cancer Research Program, specifically for improvements within the military health care system, for in-house DoD training, education, access to care, and improved detection technology programs dedicated to serving service members and their families.

**FY 1996 Accomplishments:**

- 71119 Evaluated 445 grants/contracts deemed scientifically and programmatically relevant in accordance with the 1993 Institute of Medicine Report. Conducted scientific peer review of 2511 proposals. Completed negotiations and awarded 292 grants and contracts for the FY 1995 program
- Total 71119

**FY 1997 Planned Program:**

- 95514 Conduct programmatic review and negotiate awards of grants and contracts for the FY 1996 program. Evaluate and award grants/contracts deemed scientifically and programmatically relevant to breast cancer research.
  - 2392 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 97906

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 72951          | 0              | 0              | 0              |
| Appropriated Value                | 75000          | 97906          |                |                |
| Adjustments to Appropriated Value | -3881          |                |                |                |
| FY 1998 Pres Bud Request          | 71119          | 97906          | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+97906) provided by Congressional action.

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|--|---|-------------------------------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D810</b> |
|--|---|-------------------------------|

| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|--|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D810 Industrial Base/Infectious Disease Vaccines and Drugs | 8888           | 9034             | 8274             | 8504             | 8018             | 8129             | 8674             | 9096             | Continuing       | Continuing |

**A. Mission Description and Justification:** 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 California, San Francisco, CA; SRI, Inc., Menlo Park, CA; Starks Associates, Inc., Buffalo, NY; ASH Stevens, Inc., Detroit, MI; Research Triangle Associates, Research Triangle Park, NC; Kenya Medical Research Institute, Nairobi, Kenya.

**FY 1996 Accomplishments:**

- 729 Conducted Phase I clinical safety trials of candidate *S. sonnei* NPS, *S. sonnei* LPS, and live attenuated *S. flexneri* vaccines.
- 2038 Initiated challenge studies of candidate malaria RTS,S vaccine; conducted serological analyses of serum specimens from field trials.
- 142 Conducted Phase II efficacy trial of ribavirin for treatment of viral hemorrhagic fevers.
- 781 Prepared field site for testing new antimalarial drug candidates.
- 3585 Transitioned at Milestone I one antimalarial vaccine.
- 206 Conducted field efficacy trials of camouflage facepaint repellent product and a combined repellent/sunscreen product; tested efficacy of a new repellent effective against flies.
- 1407 Prepared, purified, and bottled multivalent *shigella* and multivalent *dengue* virus candidate vaccines for human safety trials.
- Total 8888

**FY 1997 Planned Program:**

- 1671 Reformulate and test the vaccinia-vectored malaria vaccine candidate and conduct Phase I testing of the recombinant malaria vaccine candidate.
- 1497 Conduct Phase I testing of a *Shigella sonnei* proteosome-LPS intranasal vaccine, a *Shigella flexneri* live oral vaccine, and an adjuvanted multivalent killed whole cell *Campylobacter* vaccine. Microencapsulate *E. coli* antigens.
- 2693 Complete Phase I testing of topical treatment for cutaneous *Leishmaniasis*. Conduct Phase I testing of atovoquone-proguanil for prevention of multi drug-resistant malaria.
- 583 Conduct Phase I tests of attenuated *dengue* vaccine candidates. Begin the process of formulation of four attenuated monovalent candidates into one tetravalent candidate.
- 583 Document the occurrence of antimony-resistant *Leishmaniasis*, and validate the skin test and dipstick assay for *Leishmaniasis*. Field test the sunscreen/insect repellent combination and the self-supporting bednet.

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit) |  | DATE<br>February 1997     |
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| BUDGET ACTIVITY                                     | PE NUMBER AND TITLE  | PROJECT                   |
| <b>3 - Advanced Technology Development</b>          | <b>0603002A Medical Advanced Technology</b>  | <b>D810</b>               |
| <b>FY 1997 Planned Program: (continued)</b>         |  |                           |
| • 263   | Develop two improved group B meningitis vaccine candidates. Assess the sensitivity and specificity of the new dipstick diagnostic assay for scrub typhus. Evaluate the core glycolipid vaccine to prevent sepsis.                            |                           |
| • 219   | Produce technical report on the efficacy of Junin vaccine against Machupo virus, and conduct Phase I testing of a multivalent Hantavirus vaccine. Test a hepatitis E vaccine candidate in animals.   |                           |
| • 1305  | Evaluate improved production and delivery methods for vaccines including <i>dengue</i> vaccine components and four formulations of malaria peptides.   |                           |
| • 220   | Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                           |
| Total   | 9034   |                           |
| <b>FY 1998 Planned Program:</b>                     |  |                           |
| • 1525  | Conduct animal testing on a multigene <i>P. falciparum</i> DNA vaccine, a liposome encapsulated <i>P. falciparum</i> sporozoite vaccine, and a <i>P. vivax</i> sporozoite synthetic peptide vaccine.   |                           |
| • 1158  | Conduct Phase I testing of a <i>Shigella sonnei</i> nucleoprotein subcellular vaccine, and conduct animal testing of a live <i>Campylobacter</i> vaccine. Evaluate encapsulated labile toxin as a mucosal adjuvant.                          |                           |
| • 2989  | Conduct toxicology testing of a new drug to treat multi drug-resistant malaria (artelinic acid) and a new drug to prevent multi drug-resistant malaria (acridine analog).  |                           |
| • 523   | Conduct Phase I tests of an attenuated tetravalent <i>dengue</i> vaccine candidate. Standardize anti- <i>dengue</i> antibody assays.   |                           |
| • 563   | Test a dipstick for rapid detection of multi drug-resistant malaria, and initiate a survey of drug resistant <i>Leishmania</i> . Field test the computerized vector identification key.  |                           |
| • 181   | Conduct studies to optimize the parenteral group B meningitis vaccine candidate. Assess the sensitivity and specificity of the chromatographic hand-held assay for scrub typhus.   |                           |
| • 190   | Publish a technical report on the antiviral efficacy of S-adenosyl homocysteine, and conduct Phase I trials on an immunoglobulin therapy for Crimean-Congo hemorrhagic fever. Conduct Phase I testing of a hepatitis E vaccine candidate.    |                           |
| • 1145  | Evaluate improved production and delivery methods for vaccines including multiple components and formulations of <i>Shigella</i> vaccine candidates. Evaluate PCR-microchip technology for forward deployable diagnostic assays for malaria. |                           |
| Total   | 8274   |                           |
| <b>FY 1999 Planned Program:</b>                     |  |                           |
| • 1551  | Conduct animal testing on a <i>P. vivax</i> multistage recombinant attenuated vaccinia-based vaccine and a <i>P. vivax</i> multigene DNA vaccine.  |                           |
| • 1228  | Conduct animal testing of a <i>Shigella dysenteriae</i> vaccine, conduct Phase I testing of a live <i>Campylobacter</i> vaccine, and test an <i>E. coli</i> stable toxin toxoid-colonization factor antigen fusion protein.                  |                           |
| • 3101  | Conduct animal testing of a new drug to treat multi drug-resistant malaria (artelinic acid) and a new drug to prevent multi drug-resistant malaria (acridine analog).  |                           |
| Project D810  | Page 6 of 20 Pages   | Exhibit R-2 (PE 0603002A) |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D810</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 556 Conduct Phase I tests of tetravalent killed whole virus <i>dengue</i> vaccine candidate.</li> <li>• 586 Initiate a survey of drug resistant malaria, and test a new ELISA diagnostic device for <i>Leishmania</i> infections. Field test a new and safer insect repellent to replace the current DEET insect repellent product.</li> <li>• 226 Conduct studies to optimize the mucosal group B meningitis vaccine candidate. Begin the two year program to assess the sensitivity and specificity of a gene detection kit to identify antibiotic resistance genes for scrub typhus.</li> <li>• 212 Conduct Phase I testing of a vaccine to prevent sandfly fever. Test combination vaccine candidates to counter all hepatitis threats.</li> <li>• 1044 Optimize production and delivery methods for vaccines including liposome, microencapsulation, and conjugation technology. Evaluate PCR-microchip technology for forward deployable diagnostic assays for dengue.</li> </ul> <p>Total 8504</p>  |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9117</td> <td style="text-align: center;">9228</td> <td style="text-align: center;">9309</td> <td style="text-align: center;">8673</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">9373</td> <td style="text-align: center;">9034</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-485</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">8888</td> <td style="text-align: center;">9034</td> <td style="text-align: center;">8274</td> <td style="text-align: center;">8504</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY98: Funds reprogrammed (-1035) to higher priority requirements.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9117 | 9228 | 9309 | 8673 | Appropriated Value | 9373 | 9034 |  |  | Adjustments to Appropriated Value | -485 |  |  |  | FY 1998 Pres Bud Request | 8888 | 9034 | 8274 | 8504 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 9117  | 9228                          | 9309           | 8673           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 9373  | 9034                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | -485  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 8888  | 9034                          | 8274           | 8504           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p>Project D810 <span style="float: right;">Page 7 of 20 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0603002A)</span></p>   |   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D813</b> |
|--|---|-------------------------------|

| COST (In Thousands)            | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|--------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D813 Trichloromelamine Testing | 0              | 490              | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 490        |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to develop initial research models for trichloromelamine (TCM) testing that includes a 90-day toxicity disinfectant study in a non-rodent species. Purpose of test is to provide appropriate EPA registration for Army future procurement for TCM suppliers, thus ensuring competition.

**FY 1996 Accomplishments:** Program not funded in FY 96.

**FY 1997 Planned Program:**

- 478 Evaluate and award competitive contracts/grants to initiate research on trichloromelamine testing.
  - 12 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 490

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 0              | 0              | 0              | 0              |
| Appropriated Value                | 0              | 490            |                |                |
| Adjustments to Appropriated Value |                |                |                |                |
| FY 1998 Pres Bud Request          | 0              | 490            | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+490) provided by Congressional action.



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| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b> | PROJECT<br><b>D814</b> |
|---|--|------------------------|

| COST (In Thousands)    | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D814 Neurofibromatosis | 0              | 7832             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 7832       |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to develop initial research models for neurofibromatosis.

**FY 1996 Accomplishments:** Program not funded in FY 96.

**FY 1997 Planned Program:**

- 7640 Evaluate and award competitive contracts/grants to initiate research on neurofibromatosis.
  - 192 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 7832

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 0              | 0              | 0              | 0              |
| Appropriated Value                | 0              | 7832           |                |                |
| Adjustments to Appropriated Value |                |                |                |                |
| FY 1998 Pres Bud Request          | 0              | 7832           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+7832) provided by Congressional action.

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|--|--|--|--|--------------------------|---|------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D815</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| D815 National Medical Testbed  | 0                 | 5874                | 0                   | 0   | 0                   | 0                   | 0                         | 0                             | 0                   | 5874       |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, the purpose of this project is to develop initial research models for national medical testbed which display measurable improvements in cost and effectiveness in many areas of health care delivery.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5731 Evaluate and award competitive contracts/grants to initiate research on national medical testbed.</li> <li>• 143 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 5874</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border: none;"> <tr> <td></td> <td align="center"><u>FY 1996</u></td> <td align="center"><u>FY 1997</u></td> <td align="center"><u>FY 1998</u></td> <td align="center"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">0</td> <td align="right">5874</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">0</td> <td align="right">5874</td> <td align="right">0</td> <td align="right">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+5874) provided by Congressional action.</p> |                   |                     |                     |   |                     |                     |                           |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 5874 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 5874 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1997 President's Budget   | 0                 | 0                   | 0                   | 0   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Appropriated Value   | 0                 | 5874                |                     |   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value  |                   |                     |                     |   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request   | 0                 | 5874                | 0                   | 0   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |
| Project D815   |                   |                     | Page 10 of 20 Pages |   |                     |                     | Exhibit R-2 (PE 0603002A) |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |   |      |  |  |                                   |  |  |  |  |                          |   |      |   |   |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D816</b> |
|--|---|-------------------------------|

| COST (In Thousands)                         | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D816 Computer-Based Decision Support System | 0              | 5874             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 5874       |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to develop initial research models for computer-based decision support system to allow patients to better understand the diagnosis, treatment options, and risk factors associated with treatment.

**FY 1996 Accomplishments:** Program not funded in FY 96.

**FY 1997 Planned Program:**

- 5731 Evaluate and award competitive contracts/grants to initiate research on computer-based decision support system.
  - 143 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 5874

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY1997 President's Budget         | 0              | 0              | 0              | 0              |
| Appropriated Value                | 0              | 5874           |                |                |
| Adjustments to Appropriated Value |                |                |                |                |
| FY 1998 Pres Bud Request          | 0              | 5874           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+5874) provided by Congressional action.

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D817</b> |
|--|---|-------------------------------|

| COST (In Thousands)                     | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D817 Computer-Aided Diagnostic Research | 0              | 2937             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 2937       |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to develop initial research models for computer-aided diagnostic research which utilizes image enhancement and segmentation by adaptive multiresolution/multiorientation wavelet transform methods, which are suitable for more generalized application useful to DoD in digital mammography, digital x-ray imaging, and teleradiology applications.

**FY 1996 Accomplishments:** Program not funded in FY 96.

**FY 1997 Planned Program:**

- 2865 Evaluate and award competitive contracts/grants to initiate research on computer-aided diagnostic research.
  - 72 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 2937

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | FY 1996 | FY 1997 | FY 1998 | FY 1999 |
|-----------------------------------|---------|---------|---------|---------|
| FY 1997 President's Budget        | 0       | 0       | 0       | 0       |
| Appropriated Value                | 0       | 2937    |         |         |
| Adjustments to Appropriated Value |         |         |         |         |
| FY 1998 Pres Bud Request          | 0       | 2937    | 0       | 0       |

Change Summary Explanation: Funding: FY 1997: Funding (+2937) provided by Congressional action.

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| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b> | PROJECT<br><b>D818</b> |
|---|--|------------------------|

| COST (In Thousands)                   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|---------------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D818 Advanced Cancer Detection Center | 0              | 3427             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 3427       |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to develop initial research models for advanced cancer detection center for military personnel, dependents, and retired service members, using a network including a military hospital or hospitals, a regional TRICARE provider, a Department of Veteran Affairs hospital or hospitals, and a medical facility with a focused cancer center, in order to conduct coordinated screening for early detection and treatment to train military cancer specialists, and to develop improved cancer detection equipment and technology.

**FY 1996 Accomplishments:** Program not funded in FY 96.

**FY 1997 Planned Program:**

- 3343 Evaluate and award competitive contracts/grants to initiate research on advanced cancer detection center.
  - 84 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3427

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 0              | 0              | 0              | 0              |
| Appropriated Value                | 0              | 3427           |                |                |
| Adjustments to Appropriated Value |                |                |                |                |
| FY 1998 Pres Bud Request          | 0              | 3427           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+3427) provided by Congressional action.

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D819</b> |
|--|---|-------------------------------|

| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|--|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| D819 Field Medical Protection and Human Performance Enhancement-Non-Systems Advanced Development | 1683              | 2350                | 0                   | 0                   | 207                 | 202                 | 581                 | 602                 | Continuing          | Continuing |

**A. Mission Description and Justification:** This project supports laboratory validation studies and field demonstrations focused on soldier protection, sustainment, and enhancement associated with soldiers operating, wearing and consuming materiel systems in all climatic and operational conditions. Specific support includes medical 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 1996 Accomplishments:**

- 1683 Studied physical and mental performance requirements of combat soldiers to extend performance limits. Evaluated performance effects of various nutrient supplements.

Total 1683

**FY 1997 Planned Program:**

- 2293 Using noninvasive sensors and stable isotope technologies, establish a database of energy requirements and activity patterns for men and women in Army, Navy, and Marine Corps jobs to predict and plan for voluntary energy requirements.
- 57 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 2350

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

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| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b> | PROJECT<br><b>D819</b> |
|---|--|------------------------|

| <b><u>B. Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|---|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget              | 1727           | 0              | 0              | 0              |
| Appropriated Value                      | 1775           | 2350           |                |                |
| Adjustments to Appropriated Value       | -92            |                |                |                |
| FY 1998 Pres Bud Request                | 1683           | 2350           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+2350) provided by Congressional action.

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| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b> | PROJECT<br><b>D840</b> |
|---|--|------------------------|

| COST (In Thousands)           | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|-------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D840 Combat Injury Management | 2264           | 2324             | 2403             | 2455             | 2466             | 2495             | 2731             | 2845             | Continuing       | Continuing |

**A. Mission Description and Justification:** This project funds advanced development prototypes of non-system specific medical materiel 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 the University of North Carolina, Chapel Hill, NC.

**FY 1996 Accomplishments:**

- 715 Conducted human studies of candidate preservation systems for eight week refrigerated red blood cell storage.
- 732 Investigated effect of intravenous membrane oxygenation on end organ function and in prevention of respiratory insufficiency due to Adult Respiratory Distress Syndrome (ARDS).
- 318 Designed and refined engineering for prototype of the mobile Advanced Surgical Suite for Trauma Casualties (ASSTC).
- 499 Conducted initial prototyping of a ruggedized portable oxygen concentrator for field use.
- Total 2264

**FY 1997 Planned Program:**

- 716 Conduct clinical studies to evaluate fibrin-base hemostatic bandage formulation for hemorrhage control.
- 732 Evaluate clinical efficacy of oxygen administration in trauma patients.
- 199 Evaluate efficacy of tobramycin and vancomycin microspheres against antibiotic resistant strains of *P. aeruginosa*; conduct acute toxicological studies of cefazolin microspheres in two animal species to enable transition to advanced development.
- 121 Submit Investigational New Drug (IND) exemption for Phase I testing of topical analgesic/anesthetic products; complete animal testing of prototype field anesthesia machine.
- 499 Design prototype omni-directional maneuverable platform for robotic surgical assistant test bed.
- 57 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 2324



| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |                |                |
|--|--|------------------------------|----------------|----------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b>   | PROJECT<br><b>D840</b>       |                |                |
| <b>FY 1998 Planned Program:</b>                                |  |                              |                |                |
| • 602  | Complete laboratory validation of individual, far-forward version of the microwave resuscitation fluid warmer.   |                              |                |                |
| • 400  | Transition non-invasive deep tissue pH and deep tissue oxygen sensors to advanced development.   |                              |                |                |
| • 799  | Transition "Life Support for Trauma and Transport (LSTAT) 1996 Test Article" (prototype version with FDA-approved, Commercial Off The Shelf (COTS) equipment) to advanced development. |                              |                |                |
| • 602  | Transition ASSTC to advanced development.  |                              |                |                |
| Total  | 2403   |                              |                |                |
| <b>FY 1999 Planned Program:</b>                                |  |                              |                |                |
| • 802  | Transition DataPak individual physiologic sensor suite to advanced development.  |                              |                |                |
| • 851  | Transition non-invasive intracranial pressure monitor to advanced development.   |                              |                |                |
| • 802  | Transition Medical Decision Assist algorithm(s) to advanced development.   |                              |                |                |
| Total  | 2455   |                              |                |                |
| <b>B. <u>Project Change Summary</u></b>                        |  |                              |                |                |
|  | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget                                     | 2322   | 2373                         | 2397           | 2447           |
| Appropriated Value   | 2387   | 2324                         |                |                |
| Adjustments to Appropriated Value                              | -123   |                              |                |                |
| FY 1998 Pres Bud Request                                       | 2264   | 2324                         | 2403           | 2455           |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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|  |   |                               |
|--|---|-------------------------------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603002A Medical Advanced Technology</b> | <b>PROJECT</b><br><b>D887</b> |
|--|---|-------------------------------|

| COST (In Thousands)          | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D887 Ovarian Cancer Research | 0              | 7343             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 7343       |

**A. Mission Description and Justification:** By Congressional direction, the purpose of this project is to develop initial research models for a comprehensive preventative program in ovarian cancer that expands into endometrial, cervical, and other cancer research that would include prevention planning, implementation, and development planning.

**FY 1996 Accomplishments:** Program not funded in FY 96.

**FY 1997 Planned Program:**

- 7164 Evaluate and award competitive contracts/grants to initiate research on ovarian cancer research.
  - 179 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 7343

**FY 1998 Planned Program:** Program not funded in FY 98.

**FY 1999 Planned Program:** Program not funded in FY 99.

**B. Project Change Summary**

|                                   | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|-----------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget        | 0              | 0              | 0              | 0              |
| Appropriated Value                | 0              | 7343           |                |                |
| Adjustments to Appropriated Value |                |                |                |                |
| FY 1998 Pres Bud Request          | 0              | 7343           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997: Funding (+7343) provided by Congressional action.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
|--|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|--|--|--|-----------------------------------|------|--|--|--|--------------------------|------|---|---|---|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>D892</b>       |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| D892 Blood Analyzer  | 1897              | 0                   | 0                   | 0  | 0                   | 0                   | 0                         | 0                            | 0                   | 1897       |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, this project supports research on blood analyzers.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1897 Evaluated competitive contracts/grants to initiate research on blood analyzers.</li> </ul> <p>Total 1897</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <thead> <tr> <th></th> <th style="text-align: right;"><u>FY 1996</u></th> <th style="text-align: right;"><u>FY 1997</u></th> <th style="text-align: right;"><u>FY 1998</u></th> <th style="text-align: right;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">1946</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">2000</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-103</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">1897</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 1946 | 0 | 0 | 0 | Appropriated Value | 2000 |  |  |  | Adjustments to Appropriated Value | -103 |  |  |  | FY 1998 Pres Bud Request | 1897 | 0 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1997 President's Budget   | 1946              | 0                   | 0                   | 0  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Appropriated Value   | 2000              |                     |                     |  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Adjustments to Appropriated Value  | -103              |                     |                     |  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1998 Pres Bud Request   | 1897              | 0                   | 0                   | 0  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Project D892   |                   |                     | Page 19 of 20 Pages |  |                     |                     | Exhibit R-2 (PE 0603002A) |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                          |      |   |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|-------|---|---|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603002A Medical Advanced Technology</b> |                     |                           |                     | PROJECT<br><b>D893</b>       |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| D893 Tissue Replacement   | 4740              | 11749               | 0                   | 0  | 0                   | 0                         | 0                   | 0                            | 0                   | 16489      |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> By Congressional direction, this project supports tissue replacement.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4740 Began process for evaluating competitive contracts/grants to initiate research on tissue replacement.</li> </ul> <p>Total 4740</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 11462 Evaluate and award competitive contracts/grants to initiate research on tissue replacement.</li> <li>• 287 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 11749</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">4863</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">5000</td> <td align="right">11749</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-260</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">4740</td> <td align="right">11749</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997: Funding (+11749) provided by Congressional action.</p> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4863 | 0 | 0 | 0 | Appropriated Value | 5000 | 11749 |  |  | Adjustments to Appropriated Value | -260 |  |  |  | FY 1998 Pres Bud Request | 4740 | 11749 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| FY 1997 President's Budget  | 4863              | 0                   | 0                   | 0  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| Appropriated Value  | 5000              | 11749               |                     |  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| Adjustments to Appropriated Value   | -260              |                     |                     |  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| FY 1998 Pres Bud Request  | 4740              | 11749               | 0                   | 0  |                     |                           |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |
| Project D893  |                   | Page 20 of 20 Pages |                     |  |                     | Exhibit R-2 (PE 0603002A) |                     |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |   |   |

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|--|----------------|------------------|------------------|--|------------------|------------------|------------------|-----------------------|------------------|------------|
| BUDGET ACTIVITY<br>3 - Advanced Technology Development   |                |                  |                  | PE NUMBER AND TITLE<br>0603003A Aviation Advanced Technology |                  |                  |                  |                       |                  |            |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate   | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate      | Cost to Complete | Total Cost |
| Total Program Element (PE) Cost  | 48320          | 56165            | 31330            | 29921  | 39432            | 42715            | 48317            | 58612                 | Continuing       | Continuing |
| D313 Advanced Rotary Wing Vehicle Technology   | 3110           | 3453             | 6013             | 17031  | 26113            | 24474            | 29136            | 37043                 | Continuing       | Continuing |
| D391 Tractor Will  | 6104           | 4934             | 973              | 954  | 966              | 0                | 0                | 0                     | 0                | 14671      |
| D435 Aircraft Weapons  | 2809           | 0                | 0                | 0  | 3182             | 7549             | 7041             | 6691                  | Continuing       | Continuing |
| D436 Rotary-Wing MEP Integration   | 20936          | 24022            | 17366            | 5080   | 2026             | 3614             | 5178             | 7809                  | Continuing       | Continuing |
| D447 Aircraft Demonstration Engines  | 6538           | 7617             | 6580             | 6598   | 7145             | 7078             | 6962             | 7069                  | Continuing       | Continuing |
| DA38 Starstreak  | 3794           | 14686            | 0                | 0  | 0                | 0                | 0                | 0                     | 0                | 18578      |
| DB38 TRACTOR CONE  | 567            | 979              | 0                | 0  | 0                | 0                | 0                | 0                     | 0                | 582        |
| DB97 Aircraft Avionics Equipment   | 4462           | 474              | 398              | 258  | 0                | 0                | 0                | 0                     | 0                | 5686       |
| <p><b>Mission Description and Budget Item Justification:</b> The objective of this program element (PE) is to develop, demonstrate, and transition aeronautical technologies 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. Technology areas for development/demonstration include aeromechanics, aerodynamics, structures, propulsion, reliability and maintainability, safety and survivability, mission support equipment integration, aircraft subsystems, advanced helicopter rotors and flight controls, flight simulation, aircrew-aircraft system integration, aircraft weapons integration for air-to-air/air-to-ground, aircraft avionics for command and control, communications, controls and displays, digital avionics and architectures, NOE navigation, mission planning, air traffic management and investigation and selective application of Integrated Product and Process Development (IPPD) techniques in development/demonstration of these technology efforts. These technologies are continuously being researched for applications that will 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), Army</p> |                |                  |                  |  |                  |                  |                  |                       |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603003A Aviation Advanced Technology</b> |                              |
| <p>Modernization Plans, and DoD Project Reliance agreements. This program is dedicated to conducting proof-of-principle simulations, field demonstrations, and tests of technologies to meet specific military needs and is therefore appropriately funded in Budget Activity 3.</p> <p>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.</p> <p>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; Vehicle 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.</p> <p>This program adheres to DoD Project Reliance Agreements on Aeropropulsion and Air Vehicles (Rotary) with oversight (the Army is designated the lead DoD agency for rotorcraft technology) and coordination provided by the Joint Directors of Laboratories; and Training Systems with oversight and coordination provided by the Training and Personnel Systems Science &amp; 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).</p> <p>The Army participates in and with the following groups, organizations and programs for total coordination: the DoD Tri-Service Joint Technical Coordination Group for Munitions Development and Aircraft Survivability; Aircraft Instruments and Aircrew Station Working Group; the Joint Integrated Avionics Working Group (JIAWG); Integrated High Performance Turbine Engine Technology (IHPTET) Steering Committee; the Air Armament Working Party of NATO; 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 governments, and Defense Development Share Plans. Formal Memoranda of Understanding (MOUs) and Data Exchange Agreements (DEAs) with various friendly nations are actively pursued to allow technology information exchange. There is no unnecessary duplication of effort within the Army or Department of Defense.</p> |  |                              |
| <i>Page 2 of 12 Pages</i>  |  | Exhibit R-2 (PE 0603003A)    |

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603003A Aviation Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>D313</b>       |                     |            |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| D313 Advanced Rotary Wing Vehicle Technology   | 3110              | 3453                | 6013                | 17031   | 26113               | 24474               | 29136                     | 37043                        | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project provides for conduct of rotary-wing technology demonstrations in support of research for advanced rotors/controls, flight controls, airframes/structures, and drive-trains to: increase strategic/tactical mobility; increase maneuverability/agility; increase reliability through improved maintainability/sustainability and reduced operational cost. Technologies developed will be executed in four demonstrations: Rotary-Wing Structures Technology (RWST), Advanced Rotorcraft Transmission Phase II (ART-II), Rotorcraft Pilot's Associate (RPA) and Helicopter Active Control Technology (HACT). These demonstrations will focus the enabling technologies for the Joint Transport Rotorcraft (JTR) to meet the cargo/transport and commuter needs of the military and civilian sectors, as well as technology insertion for other system upgrades. This project focuses on technologies to enable rotorcraft to affordably meet future challenges from peacekeeping to the battlefield.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3110 - Initiated ART-II preliminary design.</li> <li style="padding-left: 20px;">-Completed flight testing of autonomous scout rotorcraft testbed (ASRT) demonstrators.</li> <li style="padding-left: 20px;">-Supported hotbench/platform integration of RPA technologies.</li> </ul> <p>Total 3110</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3368 -Define structural configuration and requirements and develop integrated system architecture for rapid structural concept definition as part of the RWST technology demonstration.</li> <li style="padding-left: 20px;">-Complete ART-II detailed design and initiate long lead hardware procurement.</li> <li>• 85 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3453</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4000 -Conduct ART II component validation test; evaluate and finalize ART II design and initiate procurement of final design long lead hardware.</li> <li>• 493 -Initiate HACT system definition/development.</li> <li>• 1520 -Initiate virtual structural prototype and conduct preliminary design of efficient, affordable structural concepts to satisfy configuration requirements, as part of the RWST technology demonstration.</li> </ul> <p>Total 6013</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project D313   |                   |                     | Page 3 of 12 Pages  |   |                     |                     | Exhibit R-2 (PE 0603003A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|-------|--------------------|------|------|--|--|-----------------------------------|-------|--|--|--|------------------|------|------|------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603003A Aviation Advanced Technology</b> | <b>PROJECT</b><br><b>D313</b> |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9000 -Initiate buildup of major ART-II drivetrain subsystems; perform initial testing of ART-II subsystems and conduct noise survey of ART II initial subsystems.</li> <li>• 3183 -Complete HACT system definition and initiate detailed design.</li> <li>• 4848 -Validate virtual prototype/structural configuration detailed design as part of the RWST technology demonstration.</li> </ul> <p>Total 17031</p>  |  |                               |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%;"></th> <th style="width: 15%; text-align: center;"><u>FY 1996</u></th> <th style="width: 15%; text-align: center;"><u>FY 1997</u></th> <th style="width: 15%; text-align: center;"><u>FY 1998</u></th> <th style="width: 20%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4839</td> <td style="text-align: center;">3527</td> <td style="text-align: center;">9139</td> <td style="text-align: center;">15822</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4975</td> <td style="text-align: center;">3453</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-1865</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud</td> <td style="text-align: center;">3110</td> <td style="text-align: center;">3453</td> <td style="text-align: center;">6013</td> <td style="text-align: center;">17031</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996 funding reprogrammed (-1865) to higher priority requirements.<br/> FY 1998 funding reprogrammed (-3126) to higher priority requirements.<br/> FY 1999 funding increased (+1209) to support rotary wing structures technology program</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4839 | 3527 | 9139 | 15822 | Appropriated Value | 4975 | 3453 |  |  | Adjustments to Appropriated Value | -1865 |  |  |  | FY 1998 Pres Bud | 3110 | 3453 | 6013 | 17031 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
| FY 1997 President's Budget   | 4839   | 3527                          | 9139           | 15822          |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
| Appropriated Value   | 4975   | 3453                          |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
| Adjustments to Appropriated Value  | -1865  |                               |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
| FY 1998 Pres Bud   | 3110   | 3453                          | 6013           | 17031          |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |
| Project D313   | Page 4 of 12 Pages   | Exhibit R-2 (PE 0603003A)     |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |       |  |  |  |                  |      |      |      |       |



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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|------|--------------------|------|---|--|--|-----------------------------------|------|--|--|--|--------------------------|------|---|---|---|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603003A Aviation Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>D435</b>       |                     |            |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| D435 Aircraft Weapons  | 2809              | 0                   | 0                   | 0   | 3182                | 7549                | 7041                      | 6691                         | Continuing          | Continuing |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| <p><b>A. Mission Description and Justification:</b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2809 -Completed weapons and target acquisition knowledge development portion of mission operation as part of the RPA detailed design.</li> <li style="padding-left: 20px;">-Completed development of RPA weapons and target acquisition simulation models.</li> <li style="padding-left: 20px;">-Conducted detailed design of the Cognitive Decision Aiding (CDA) Attack Planner for RPA.</li> </ul> <p>Total 2809</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2881</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1918</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2963</td> <td style="text-align: center;">0</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-154</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2809</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1999 funding reprogrammed (-1918) to higher priority requirements.</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2881 | 0 | 0 | 1918 | Appropriated Value | 2963 | 0 |  |  | Adjustments to Appropriated Value | -154 |  |  |  | FY 1998 Pres Bud Request | 2809 | 0 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1997 President's Budget   | 2881              | 0                   | 0                   | 1918  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Appropriated Value   | 2963              | 0                   |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Adjustments to Appropriated Value  | -154              |                     |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| FY 1998 Pres Bud Request   | 2809              | 0                   | 0                   | 0   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |
| Project D435   |                   |                     | Page 5 of 12 Pages  |   |                     |                     | Exhibit R-2 (PE 0603003A) |                              |                     |            |  |                |                |                |                |                            |      |   |   |      |                    |      |   |  |  |                                   |      |  |  |  |                          |      |   |   |   |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603003A Aviation Advanced Technology</b> | <b>PROJECT</b><br><b>D436</b> |
|--|--|-------------------------------|

| COST (In Thousands)              | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|----------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D436 Rotary-Wing MEP Integration | 20936          | 24022            | 17366            | 5080             | 2026             | 3614             | 5178             | 7809             | Continuing       | Continuing |

**A. Mission Description and Justification:** The objective of this project is to demonstrate man-machine integration and mission equipment technology to provide enhanced helicopter pilotage capability, improved crew workload distribution and improved overall mission execution. This is the primary project for the Rotorcraft Pilot's Associate (RPA) Advanced Technology Demonstration (ATD). It provides for the demonstration of rotorcraft crew stations utilizing knowledge-based information systems to develop Cognitive Decision Aiding (CDA) for crews. Advanced technology in information technology computing methods, sensors, displays, and controls will be demonstrated to maximize combat helicopter mission effectiveness and survivability for day/night adverse weather operations. The project provides for the demonstration of simulation capability to evaluate combined rotorcraft control and crew performance via virtual prototyping and Distributed Interactive Simulation (DIS). The RPA system will use state-of-the-art approaches in artificial intelligence, sensors, avionics, communications, and pilot vehicle interfaces, that augments the battlefield effectiveness of Army aviation.

**FY 1996 Accomplishments:**

- 13007 -Completed RPA hardware detail design and software system builds 2 and 3, initiated fabrication, modification, and integration activities for the flight test vehicle.  
-Completed high fidelity engineering simulation environment to support development and engineering evaluation of the RPA; included full fidelity mission equipment models that interface directly with RPA core architecture.  
-Continued knowledge acquisition collection and refinement for scout/attack and Special Operations aviation forces mission.
  - 7929 -Maintained and improved combined arms simulation capabilities through SPIRIT commitments.  
-Refined operational evaluation techniques and performed RPA system performance evaluations during concurrent software development activities.
- Total 20936

**FY 1997 Planned Program:**

- 18591 -Complete knowledge acquisition collection activities and software detailed design; perform system builds 4, 5 and 6; conduct software critical design review.  
-Conduct engineering and full mission simulation System Formal Evaluations I & II.  
-Perform subsystems integration, ground-based testing, and airborne validation in preparation for the FY 1998 RPA system flight evaluation at Fort Hunter-Leggett.
- 4844 -Maintain and improve combined arms simulation capabilities through SPIRIT commitments.

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|------------------|-------|-------|-------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603003A Aviation Advanced Technology</b> | <b>PROJECT</b><br><b>D436</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                  |       |       |       |      |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>-Refine operational evaluation techniques and perform RPA system performance evaluations during concurrent software development activities in preparation for the FY 1998 full system combined arm distributed simulation warfighting evaluations.</li> <li>•           587 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total       24022</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•           17366 -Complete development of core architecture software; integrate and test Version 6 software; conduct performance demonstration; conduct engineering/integration flight testing; conduct operational evaluation flight testing; conduct government/industry system demonstrations (simulation and flight test).</li> </ul> <p>Total       17366</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•           5080 -Complete RPA simulation and flight test; complete data reduction, analysis, final report/briefing and transition RPA technology and lessons learned to fielded/development systems and follow-ons.</li> </ul> <p>Total       5080</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">20650</td> <td style="text-align: center;">24647</td> <td style="text-align: center;">18261</td> <td style="text-align: center;">14672</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">21230</td> <td style="text-align: center;">24022</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-294</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud</td> <td style="text-align: center;">20936</td> <td style="text-align: center;">24022</td> <td style="text-align: center;">17366</td> <td style="text-align: center;">5080</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1999 funding reprogrammed (-9592) to higher priority requirements.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 20650 | 24647 | 18261 | 14672 | Appropriated Value | 21230 | 24022 |  |  | Adjustments to Appropriated Value | -294 |  |  |  | FY 1998 Pres Bud | 20936 | 24022 | 17366 | 5080 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                  |       |       |       |      |
| FY 1997 President's Budget   | 20650  | 24647                         | 18261          | 14672          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                  |       |       |       |      |
| Appropriated Value   | 21230  | 24022                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                  |       |       |       |      |
| Adjustments to Appropriated Value  | -294   |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                  |       |       |       |      |
| FY 1998 Pres Bud   | 20936  | 24022                         | 17366          | 5080           |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                  |       |       |       |      |
| Project D436   | Page 7 of 12 Pages   | Exhibit R-2 (PE 0603003A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                  |       |       |       |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                           |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                           | <b>PE NUMBER AND TITLE</b><br><b>0603003A Aviation Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D447</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate       | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D447 Aircraft Demonstration Engines  | 6538              | 7617                | 6580                      | 6598   | 7145                | 7078                | 6962                      | 7069                          | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 6538 -Completed initial JTAGG II component test.<br/>-Performed gas generator fabrication and build-up.<br/>-Initiated gas generator test.</li> </ul> <p>Total 6538</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7430 -Complete final component updated design.<br/>-Perform final component fabrication.<br/>-Perform final component tests.<br/>-Initiate JTAGG fabrication and build-up .</li> <li>• 187 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 7617</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6580 -Complete endurance testing of JTAGG II, evaluate results and complete final report .</li> </ul> <p>Total 6580</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6598 -Complete JTAGG III detail design, procure long-lead hardware and conduct initial component testing.</li> </ul> <p>Total 6598</p> |                   |                     |                           |  |                     |                     |                           |                               |                     |            |
| Project D447   |                   |                     | <i>Page 8 of 12 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0603003A) |                               |                     |            |

**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)** DATE **February 1997**

BUDGET ACTIVITY **3 - Advanced Technology Development**      PE NUMBER AND TITLE **0603003A Aviation Advanced Technology**      PROJECT **D447**

| <b>B. <u>Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|---|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget              | 6963           | 7780           | 6588           | 6608           |
| Appropriated Value                      | 7158           | 7617           |                |                |
| Adjustments to Appropriated Value       | -620           |                |                |                |
| FY 1998 President's Budget Request      | 6538           | 7617           | 6580           | 6598           |

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|-----------------------------|------|---|---|---|--------------------|------|-------|--|--|-----------------------------------|------|--|--|--|--|------|-------|---|---|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603003A Aviation Advanced Technology</b> |                     |                     |                     | PROJECT<br><b>DA38</b>       |                     |            |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| DA38 Starstreak  | 3794              | 14686               | 0                   | 0   | 0                   | 0                   | 0                   | 0                            | 0                   | 18578      |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| <p><b>A. Mission Description and Justification:</b> The objective of this Congressionally mandated 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. A missile system cost estimate will be performed as part of a preliminary assessment of the military worth of the Starstreak missile as an ATA self defense weapon.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3794 -Conducted safe separation testing of Starstreak missile firings from an AH-64, completed data analysis and published findings.</li> <li>-Awarded Technical Demonstration (TD) contract to conduct live fire tests from an AH-64 to assess technical feasibility of the Starstreak missile/ rotorcraft integration as an ATA self-defense weapon.</li> <li>-Conducted safe separation live fire tests using the Apache / Starstreak.</li> <li>-Conducted limited simulation evaluations of Apache / Starstreak warfighting effectiveness in the ATA self-defense role.</li> </ul> <p>Total 3794</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 14327 -Conduct detailed design, analysis and simulation, including TADS/LGU integration and crew station integration; fabricate and integrate AH-64A and Starstreak system modifications; conduct modeling and simulation of the integrated system in a few-on-few environment; conduct demonstration flight testing including airborne tracking trials, flight envelope verification, and live fire tests against airborne targets.</li> <li>• 359 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 14686</p> <p><b>FY 1998 Planned Program:</b> Effort completed with FY 1997 funding.</p> <p><b>FY 1999 Planned Program:</b> Effort completed with FY 1997 funding.</p> <p><b>B. Project Change Summary</b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>Previous President's Budget</td> <td style="text-align: center;">3892</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4000</td> <td style="text-align: center;">14686</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-206</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Current Budget Submit/President's Budget</td> <td style="text-align: center;">3794</td> <td style="text-align: center;">14686</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> |                   |                     |                     |   |                     |                     |                     |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | Previous President's Budget | 3892 | 0 | 0 | 0 | Appropriated Value | 4000 | 14686 |  |  | Adjustments to Appropriated Value | -206 |  |  |  | Current Budget Submit/President's Budget | 3794 | 14686 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                     |                              |                     |            |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| Previous President's Budget  | 3892              | 0                   | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| Appropriated Value   | 4000              | 14686               |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| Adjustments to Appropriated Value  | -206              |                     |                     |   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| Current Budget Submit/President's Budget   | 3794              | 14686               | 0                   | 0   |                     |                     |                     |                              |                     |            |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |
| Project DA38   |                   |                     |                     | Page 10 of 12 Pages   |                     |                     |                     | Exhibit R-2 (PE 0603003A)    |                     |            |  |                |                |                |                |                             |      |   |   |   |                    |      |       |  |  |                                   |      |  |  |  |  |      |       |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603003A Aviation Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>DB97</b>       |                     |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| DB97 Aircraft Avionics Equipment  | 4462              | 474                 | 398                 | 258   | 0                   | 0                   | 0                         | 0                            | 0                   | 5686       |
| <p><b>A. Mission Description and Justification:</b> This project supports development and demonstration of advanced, integrated avionics equipment in support of aviation integration into the digitized battlefield. Evolving concepts in digital avionics will provide new functional capability in the areas of situational awareness, flight path guidance, position reporting and digital data transfer. Work in this project supports the Rotorcraft Pilot's Associate (RPA) program. The project effort in the out years will pursue application of low cost avionics integration/demonstration based on commercial products/technologies.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1742 -Provided RPA mission equipment integration support in the areas of communication, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence.<br/>-Completed knowledge acquisition sessions on communications, navigation, and pilotage aspects of mission operation.<br/>-Completed development of communications, navigation, and pilotage simulation models.</li> <li>• 2720 -Conducted detail design and evaluation of the data fusion algorithms including direct stimulus from the mission equipment simulation models.<br/>-Conducted detail design of the RPA hardware.</li> </ul> <p>Total 4462</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 462 -Provide RPA mission equipment integration support in the areas of communication, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence.</li> <li>• 12 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 474</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 398 -Provide RPA mission equipment integration support in the areas of communication, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence.</li> </ul> <p>Total 398</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 258 -Provide RPA mission equipment integration support in the areas of communication, navigation, pilotage, voice recognition, controls and displays, and artificial intelligence.</li> </ul> <p>Total 258</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project DB97  |                   |                     | Page 11 of 12 Pages |   |                     |                     | Exhibit R-2 (PE 0603003A) |                              |                     |            |

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|---|---|------------------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> | PE NUMBER AND TITLE<br><b>0603003A Aviation Advanced Technology</b> | PROJECT<br><b>DB97</b> |
|---|---|------------------------|

| <b><u>B. Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|---|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget              | 4577           | 484            | 385            | 240            |
| Appropriated Value                      | 4705           | 474            |                |                |
| Adjustments to Appropriated Value       | -243           |                |                |                |
| FY 1998 President's Budget              | 4462           | 474            | 398            | 258            |



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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603004A Weapons and Munitions Advanced Technology</b> |
|--|---|

| COST ( <i>In Thousands</i> )                    | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|---|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| Total Program Element (PE) Cost                 | 29119             | 29122               | 18255               | 29717               | 38074               | 42361               | 43405               | 42488               | Continuing          | Continuing |
| DL94 Electric Gun Systems Demonstrations        | 0                 | 0                   | 0                   | 482                 | 5720                | 5367                | 5569                | 5948                | Continuing          | Continuing |
| DL95 Landmine Warfare Development               | 3427              | 2117                | 0                   | 0                   | 0                   | 0                   | 0                   | 0                   | 0                   | 5544       |
| D43A Advanced Weaponry Technology Demonstration | 20712             | 21353               | 6234                | 17691               | 17830               | 20113               | 21098               | 20660               | Continuing          | Continuing |
| D232 Advanced Munitions Demonstration           | 4980              | 5652                | 12021               | 11544               | 14524               | 16881               | 16738               | 15880               | Continuing          | Continuing |

**Mission Description and Budget Item Justification:** The objective of this Program Element (PE) is to demonstrate affordable, advanced weapons and munitions technologies that will increase battlefield lethality and survivability. This PE funds several stand-off, anti-armor weapons demonstrations within the Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD) to significantly increase the capability of Early Entry Forces. The RFPI demonstrations funded within this PE include: the Precision Guided Mortar Munition (PGMM), Autonomous Intelligent Submunition (AIS-Damocles), and more responsive digitized fire control for a towed 155mm automated howitzer (AH). An initiative in response to recent threat information, especially against new explosive reactive armors (which appears as appliqué), is the Direct Fire Lethality Program, the purpose of which is to significantly enhance anti-tank lethality in terms of hit and kill by maximizing warhead/penetrator effectiveness and significantly increase tank gun accuracy under dynamic battlefield conditions. In the area of combat vehicle anti-armor munitions, advanced explosively formed penetrator warheads exploit technologies in explosives, liner materials and modeling, and demonstrate increased armor penetration through advanced warhead concepts. Technologies were Congressionally supported in FY1996 to demonstrate an artillery projectile capable of delivering dual purpose improved conventional munition (DPICM) cargo to ranges in excess of 40 kilometers. Innovative applications for electro-rheological (ER) fluids are also Congressionally supported in FY1996 and FY1997 for use in next generation artillery recoil mechanisms. 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 (ARDEC), Picatinny Arsenal, NJ. This program adheres to Tri-Service Reliance Agreements on conventional air-surface weaponry with oversight provided by the Joint Directors of Laboratories. Work in this PE is related to and fully coordinated with efforts in PE 0602624A (Weapons and Munitions Technology), PE 0602618A (Ballistics Tech) and PE 0604802A (Weapons and Munitions-Engineering Development). 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.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603004A Weapons and Munitions Advanced Technology</b> |                     |                           |                     | PROJECT<br><b>DL94</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| DL94 Electric Gun Systems Demonstrations  | 0                 | 0                   | 0                   | 482  | 5720                | 5367                      | 5569                | 5948                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> Recognizing that the feasibility of electric guns depends on overcoming fundamental technical barriers, the Army's electric gun program is structured to accelerate electronics and hypervelocity physics research, thereby understanding the fundamental underpinnings of electric guns. Accordingly, the program is managed by the Army Research Laboratory (ARL) for their unique expertise in physics research. Once the fundamental technical barriers are identified, the program will be transitioned to ARDEC for evaluation against the requirements of Army systems.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96. Electric gun efforts funded in PE/Project 0602618/AH75.</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97. Electric gun efforts funded in PE/Project 0602618/AH75.</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98. Electric gun efforts funded in PE/Project 0602618/AH75.</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 482 - Finalize acquisition strategy for Future Combat System (FCS) main armament system; conduct testing of Focused Technology Program (FTP) compulsator.</li> </ul> <p>Total 482</p> |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| <b>B. <u>Project Change Summary</u></b>   |                   |                     | <u>FY 1996</u>      | <u>FY 1997</u>   | <u>FY 1998</u>      | <u>FY 1999</u>            |                     |                              |                     |            |
| FY 1997 President's Budget Appropriated Value   |                   |                     | 0                   | 0  | 0                   | 482                       |                     |                              |                     |            |
| Adjustments to Appropriated Value   |                   |                     |                     |  |                     |                           |                     |                              |                     |            |
| FY 1998 Pres Bud Request  |                   |                     | 0                   | 0  | 0                   | 482                       |                     |                              |                     |            |
| Project DL94  |                   |                     | Page 2 of 9 Pages   |  |                     | Exhibit R-2 (PE 0603004A) |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603004A Weapons and Munitions Advanced Technology</b> |                     |                     |                     |                              | PROJECT<br><b>DL95</b> |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| DL95 Landmine Warfare Development  | 3427              | 2117                | 0                   | 0  | 0                   | 0                   | 0                   | 0                            | 0                      | 5544       |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project funds the Intelligent Minefield (IMF) demonstration, which is an anti-armor weapon candidate under the Rapid Force Projection Initiative (RFPI) and which provides product improvement opportunities for the Wide Area Munition (WAM). 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. The IMF advanced acoustic sensor sub-system re-configured as the integrated acoustic system (IAS) is a key residual sensor component of the RFPI ACTD Program. In-house efforts are accomplished by Armament Research Development and Engineering Center, Picatinny Arsenal, NJ.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1973 - Conducted mission analysis, systems analysis and engineering of the IMF system.             <ul style="list-style-type: none"> <li>- Designed, fabricated and integrated ATD hardware for use with WAM surrogates.</li> <li>- Developed algorithms for improved IMF performance and integrated into gateway and IMF simulator.</li> </ul> </li> <li>• 1454 - Completed development of the distributed interactive simulation (DIS) compatible IMF simulator.             <ul style="list-style-type: none"> <li>- Completed development and test of near and deep deployed acoustic sensors and associated communications links for RFPI.</li> </ul> </li> </ul> <p>Total 3427</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2069 - Complete IMF ATD including analysis and report.             <ul style="list-style-type: none"> <li>- Modify advanced acoustic sensors to meet RFPI ACTD "residual" requirements.</li> <li>- Conduct field test and system integration of integrated acoustic system for RFPI ACTD.</li> </ul> </li> <li>• 48 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</li> </ul> <p>Total 2117</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> |                   |                     |                     |  |                     |                     |                     |                              |                        |            |
| Project DL95   |                   |                     |                     | Page 3 of 9 Pages  |                     |                     |                     | Exhibit R-2 (PE 0603004A)    |                        |            |

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|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|---|---|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603004A Weapons and Munitions Advanced Technology</b> | <b>PROJECT</b><br><b>DL95</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2897</td> <td style="text-align: center;">2178</td> <td style="text-align: center;">2402</td> <td style="text-align: center;">4608</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2978</td> <td style="text-align: center;">2117</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+449</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">3427</td> <td style="text-align: center;">2117</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996 funds increased (+530) for development of acoustic sensors for the RFPI.<br/> FY 1998 funds reprogrammed (-2402) to higher priority requirements.<br/> FY 1999 funds reprogrammed (-4608) to higher priority requirements.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2897 | 2178 | 2402 | 4608 | Appropriated Value | 2978 | 2117 |  |  | Adjustments to Appropriated Value | +449 |  |  |  | FY 1998 Pres Bud Request | 3427 | 2117 | 0 | 0 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1997 President's Budget   | 2897  | 2178                          | 2402           | 4608           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Appropriated Value   | 2978  | 2117                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Adjustments to Appropriated Value  | +449  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1998 Pres Bud Request   | 3427  | 2117                          | 0              | 0              |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Project DL95   | Page 4 of 9 Pages   | Exhibit R-2 (PE 0603004A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603004A Weapons and Munitions Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>D43A</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| D43A Advanced Weaponry Technology Demonstration  | 20712             | 21353               | 6234                | 17691  | 17830               | 20113               | 21098                     | 20660                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project includes the non-missile stand-off weapon residuals and advanced concepts for the Rapid Force Projection Initiative (RFPI) Advanced Concept Technology Demonstration (ACTD) and lethality enhancements under the Direct Fire Lethality Program. Weapon 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 affordable, extended range, top-attack, high value target capability for light forces. It has included assessments of both 81mm and 120mm non-developmental item candidates and will demonstrate a 120mm PGMM. Large footprint, smart munition sensor technologies applicable to the Multiple Launch Rocket System (MLRS) will also be evaluated. Increased sensor footprints are important to provide capabilities to attack moving targets. Towed howitzer fire control enhancements applicable to both Army and Marine Corps artillery requirements are included under the RFPI ACTD. A key RFPI ACTD residual sensor, integrated acoustic system (IAS), will be fabricated. A 105mm guided projectile will be evaluated in FY1999. The 105mm terminally guided projectile (TGP) will provide the demonstration of an autonomous and laser guided projectile that will give an extended range direct support artillery capability to the light forces. Most of these concepts being demonstrated are candidates for technology insertions and most provide significant enhancement to early entry forces. A FY1997 Congressionally-mandated Extended Range Artillery projectile (XM982) program develops required technology for resolving the Army's artillery range deficit. The XM982 is a 155mm artillery cargo projectile that uses both rocket assist and base burn to achieve longer range, up to 47 kilometers with the Crusader solid propellant system. The XM982 program will demonstrate the technical feasibility and operational potential of this projectile, including accuracy enhancements afforded by an autoregistration fuze. The XM982 component technology and autoregistration fuze transitioned from applied research activities funded under PE 0602624A and PE 0602618A. In FY1996 and FY 1997 Congress also mandated applications for electro-rheological (ER) fluids for use in next generation artillery recoil mechanisms. Most of the concepts to be demonstrated are candidates for technology insertions and most provide significant enhancement to early entry forces. In FY 1999, this project will initiate integration of components and demonstrate the unmanned terrain domination concepts: area denial system and anti-personnel landmine alternatives. In-house efforts are accomplished by Armament Research Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp. (SAIC), McLean, VA; LTV Aerospace, Dallas, TX; Textron, Lowell, MA; Ferrulmatic, Inc., Totowa, NJ; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; Olin-Flinchbaugh, Red Lion, PA; Textron, Inc., Willington, MA; Technical Solutions Incorporated (TSI), Mesina Park, NM; Motorola, Scottsdale, AZ; Lockheed Martin, Sunnyvale, CA; MEI Technology, Lexington, MA; Computing Device International, Minneapolis, MN; Singer Kearfott, Wayne, NJ; Diehl GmbH., Rothenbach, Germany.</p> |                   |                     |                     |  |                     |                     |                           |                              |                     |            |
| Project D43A   |                   |                     | Page 5 of 9 Pages   |  |                     |                     | Exhibit R-2 (PE 0603004A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  | PE NUMBER AND TITLE<br><b>0603004A Weapons and Munitions Advanced Technology</b>   | PROJECT<br><b>D43A</b>       |
| <b>FY 1996 Accomplishments:</b>                                |  |                              |
| • 9412   | - Continued contractor effort for PGMM subsystem integration and testing; conducted hi-g testing of seeker, guidance and control and projectile structural components; conducted 120mm PGMM projectile extended range glide test out to eight km; procured mortar fire control lightweight components  |                              |
|  | - Demonstrated PGMM warhead lethality against earth and timber bunkers.  |                              |
| • 921  | - Completed fabrication of subscale and design of full scale electro-rheological (ER) fluid recoil prototype for live fire demonstration.  |                              |
| • 3000   | - Initiated liquid propellant testing to evaluate oscillation reduction techniques; initiated tests of ignition flow visualization and material compatibility.   |                              |
| • 5538   | - Completed AIS-Damocles captive carry test against real time critical targets and incorporated target models for RFPI Advanced Concept Technology Demonstration (ACTD) testing.<br>- Procured digitized fire control components for testing integration onto 155mm towed howitzer.  |                              |
| • 1841   | - Successfully completed spin testing and ballistic structural integrity testing of the advanced XM982 155mm projectile design incorporating a larger, two-piece, rocket grain, scalloped carrier and dual output fuze.  |                              |
| Total  | 20712  |                              |
| <b>FY 1997 Planned Program:</b>                                |  |                              |
| • 10142  | - Conduct 105/120mm common tactical seeker captive flight test (CFT); complete integration of seeker and air frame and conduct 'high g' test; develop software for mortar fire control ballistic computer and fire control simulator; modify PGMM system hardware-in-the-loop.<br>- Fabricate and test towed howitzer fire control units for RFPI ACTD training.<br>- Procure towed howitzer fire control lab system for RFPI system integration.<br>- Test and integrate fire control hardware and software for 155mm automated howitzer. |                              |
| • 10714  | - Conduct XM982 extended range artillery risk reduction testing (range precision, expulsion, dual function fuze, wind tunnel)<br>- Conduct electro-rheological (ER) fluid recoil test fire and refinements.<br>- Conduct AIS-Damocles captive carry test against RFPI targets and participate in RFPI ACTD simulation as an advanced concept.  |                              |
| • 497  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs   |                              |
| Total  | 21353  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 4301   | - Complete projectile integration; initiate PGMM experiments for RFPI ACTD (extended flight demo, telemetry demo).   |                              |
| • 1933   | - Conduct field experiment for the 155mm automated howitzer with XVIII Airborne Corps.<br>- Develop tactics, techniques and procedures (TTPs) for the 155mm automated howitzer.<br>- Upgrade one battery with digitized fire control system (DFCS); conduct RFPI field experiment.<br>- Residual hardware fabrication (partial) for RFPI ACTD.   |                              |
| Project D43A   | Page 6 of 9 Pages  | Exhibit R-2 (PE 0603004A)    |

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|  |   |                               |                           |                |
|--|---|-------------------------------|---------------------------|----------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                           |                |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603004A Weapons and Munitions Advanced Technology</b> | <b>PROJECT</b><br><b>D43A</b> |                           |                |
| Total            6234  |   |                               |                           |                |
| <b>FY 1999 Planned Program:</b> <ul style="list-style-type: none"> <li>•            10118 - Design detailed terminally guided projectile (TGP) and test TGP subsystem performance.<br/>                                           - Support towed howitzer and IAS RFPI extended user evaluation residual effort.<br/>                                           - Initiate fabrication of prototype area denial system hardware.<br/>                                           - Complete PGMM RFPI ACTD experiments (i.e., CFT, extended flight demo, telemetry demo) and producibility evaluation.</li> <li>•            7051 - Fabricate hardware and demonstrate on dynamic simulator, a tank turret/drive system with reduced stabilization error.</li> <li>•            522 - Initiate medium caliber ammunition enhancements for defeat of future light armored threat.</li> </ul> Total            17691 |   |                               |                           |                |
| <b>B. <u>Project Change Summary</u></b>  |   |                               |                           |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 1997 President's Budget   | 18763   | 11809                         | 9862                      | 20263          |
| Appropriated Value   | 19290   | 21353                         |                           |                |
| Adjustments to Appropriated Value  | +1422   |                               |                           |                |
| FY 1998 Pres Bud Request   | 20712   | 21353                         | 6234                      | 17691          |
| Change Summary Explanation: <ul style="list-style-type: none"> <li>Funding: FY 1996 funds increased (+1949) for liquid propellant technology effort.</li> <li>          FY 1997 funds increased (+2000) for Damocles, (+5000) for XM982 extended range projectile and (+3000) for ER fluids efforts.</li> <li>          FY 1998 funds reprogrammed (-3628) to higher priority requirements.</li> <li>          FY 1999 funds reprogrammed (-2572) to higher priority requirements.</li> </ul>  |   |                               |                           |                |
| Project D43A   |   | Page 7 of 9 Pages             | Exhibit R-2 (PE 0603004A) |                |

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|-------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603004A Weapons and Munitions Advanced Technology</b> |                     |                     |                     | <b>PROJECT</b><br><b>D232</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D232 Advanced Munitions Demonstration  | 4980              | 5652                | 12021               | 11544   | 14524               | 16881               | 16738               | 15880                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> The direct fire lethality program will enhance tank kinetic energy (KE) penetrator lethality, particularly against explosively reactive armor (ERA) appliqué arrays, through use of a precursor defeat mechanism. The program will demonstrate range and lethality enhancements for tank munitions and demonstrate the emerging technologies needed to defeat the active protection system (APS) threat. In the near term, this project demonstrates advanced warhead and cartridge concepts, utilizing novel explosively formed penetrators (EFP) and shaped charged designs, that can be applied to product improvements to fielded and developmental anti-armor munitions, e.g., autonomous intelligent submunition (AIS-Damocles), wide area munitions (WAM), smart target activated fire and forget (STAFF), 120mm chemical energy (CE) cartridge and The 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. This project will fund demonstrations of advanced fuzes for near term munitions concepts. Low Cost Competent Munition (LCCM) concepts integrating global positioning system (GPS), fuzing, and possibly guidance and control (G&amp;C) technology are being developed for artillery projectiles. The resulting screw-on module will significantly increase a projectile's overall delivery accuracy and also be readily applicable to the existing stockpile of 155mm artillery projectiles. In-house efforts are accomplished by Armament Research Development and Engineering Center, Picatinny Arsenal, NJ and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp. (SAIC), McLean, VA; LTV Aerospace, Dallas, TX; Textron Defense Systems, Wilmington, MA; Ferrulmatic, Inc., Totowa, NJ; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; and Olin-Flinchbaugh, Red Lion, PA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2503 - Demonstrated 25% increase in armor penetration in a top attack submunition type warhead.</li> <li>• 2477 - Completed integrated kinetic energy precursor penetrator design.</li> <li style="padding-left: 20px;">- Formulated concept for an advanced dual EFP liner warhead for STAFF lethality upgrade to defeat advanced armors.</li> </ul> <p>Total 4980</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5524 - Conduct defeat of explosive reactive armor (ERA) proof of principle demonstration with KE precursor.</li> <li style="padding-left: 20px;">- Design/develop enhanced STAFF dual-liner EFP warhead and conduct function demonstrations.</li> <li style="padding-left: 20px;">- Fabricate prototype LCCM auto-registration system for FY1998 flight testing; refine and test GPS translator components.</li> <li>• 128 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</li> </ul> <p>Total 5652</p> <p>Project D232 <span style="float: right;">Page 8 of 9 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0603004A)</span></p> |                   |                     |                     |   |                     |                     |                     |                               |                     |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |
|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|-------|-------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603004A Weapons and Munitions Advanced Technology</b> | <b>PROJECT</b><br><b>D232</b> |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 11537 - Complete KE defeat of ERA integrated cartridge design; initiate fabrication of demonstration hardware.<br/>- Optimize design of dual-liner EFP warhead and complete functional demonstrations.<br/>- Complete full-up system demonstration of LCCM auto-registration system; complete Milestone I; transition to engineering and manufacturing development (EMD).</li> <li>• 484 - Initiate design of an optimized main charge and a candidate precursor warhead to defeat APS.</li> </ul> <p>Total 12021</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 11544 - Conduct advanced KE cartridge technology maturation demonstrations and performance demonstration of ERA defeat.<br/>- Initiate 3 year system demo of 2-D/3-D LCCM self-correcting concept.<br/>- Demonstrate a tactical long standoff warhead to defeat APS by defeating range targets in a realistic atmosphere.</li> </ul> <p>Total 11544</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5100</td> <td style="text-align: center;">5772</td> <td style="text-align: center;">12047</td> <td style="text-align: center;">11574</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5242</td> <td style="text-align: center;">5652</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-262</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4980</td> <td style="text-align: center;">5652</td> <td style="text-align: center;">12021</td> <td style="text-align: center;">11544</td> </tr> </tbody> </table> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5100 | 5772 | 12047 | 11574 | Appropriated Value | 5242 | 5652 |  |  | Adjustments to Appropriated Value | -262 |  |  |  | FY 1998 Pres Bud Request | 4980 | 5652 | 12021 | 11544 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |
| FY 1997 President's Budget   | 5100  | 5772                          | 12047          | 11574          |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |
| Appropriated Value   | 5242  | 5652                          |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |
| Adjustments to Appropriated Value  | -262  |                               |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |
| FY 1998 Pres Bud Request   | 4980  | 5652                          | 12021          | 11544          |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |
| Project D232   | Page 9 of 9 Pages   | Exhibit R-2 (PE 0603004A)     |                |                |                |                |                |                            |      |      |       |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |       |       |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                   |                     |                     |  |                     |                     |                     |                     | DATE<br>February 1997 |            |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------|---------------------|-----------------------|------------|
| BUDGET ACTIVITY<br>3 - Advanced Technology Development  |                   |                     |                     | PE NUMBER AND TITLE<br>0603005A Combat Vehicle and Automotive<br>Advanced Technology |                     |                     |                     |                     |                       |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete   | Total Cost |
| Total Program Element (PE) Cost   | 26363             | 28811               | 32685               | 59573  | 65140               | 65677               | 55464               | 70590               | Continuing            | Continuing |
| DC62 TRACTOR UNION  | 0                 | 3198                | 18616               | 26401  | 17424               | 12288               | 0                   | 0                   | 0                     | 77927      |
| D221 Combat Vehicle Survivability   | 11353             | 4659                | 690                 | 690  | 1633                | 958                 | 10954               | 13850               | Continuing            | Continuing |
| D440 Advanced Combat Vehicle Technology   | 11527             | 13101               | 4256                | 20325  | 34162               | 38310               | 23258               | 31104               | Continuing            | Continuing |
| D441 Combat Vehicle Mobility Technology   | 2516              | 4115                | 2949                | 4816   | 3350                | 4700                | 10500               | 12673               | Continuing            | Continuing |
| D497 Combat Vehicle Electronics   | 967               | 1780                | 6174                | 7341   | 8571                | 9421                | 10752               | 12963               | Continuing            | Continuing |
| D502 HAECO II   | 0                 | 1958                | 0                   | 0  | 0                   | 0                   | 0                   | 0                   | 0                     | 1958       |
| <p><b>Mission Description and Budget Item Justification:</b> This program demonstrates the feasibility and operational potential of technologies which contribute to upgrades of fielded combat vehicles and more advanced ground combat vehicle systems. It places emphasis on solutions to post-Cold War deficiencies, providing opportunities for more affordable, deployable, survivable, horizontally integrated and lethal power projection capabilities than are currently available. The technology areas supported by this program element include: survivability, mobility, digital intra-vehicular electronics, and integration of diverse vehicle technologies developed by the Army, other DoD laboratories and industry. Initiatives conducted under this program element that support land combat on the horizontal battlefield include the introduction of: composite materials to reduce the weight of ground vehicle components, vehicle structures and armor; integrated survivability to increase survivability with less weight burden than ballistic armor and better capabilities against smart or precision guided munitions; combat vehicle performance enhancements and crew size reduction through automation of crew functions and optimized crew/vehicle integration; advanced mobility technologies to improve agility, propulsion system size and weight reduction; and lower operation and support costs by implementation of a low cost, non-developmental advanced combat vehicle electronics and a standards based electronics architecture with digitized vehicle sub-systems. Work in this program element is consistent with the Army Science and Technology Master Plan, Science and Technology Objectives, Army Modernization Plan, and the Ground and Sea Vehicle Defense Technology Area Plan (DTAP). This 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 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.</p> |                   |                     |                     |  |                     |                     |                     |                     |                       |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D221</b> |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D221 Combat Vehicle Survivability  | 11353             | 4659                | 690                 | 690   | 1633                | 958                 | 10954                     | 13850                         | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project demonstrates near term, advanced technologies for horizontal protection against smart, precision guided and other munitions threats to ground combat vehicles. A front end battlefield operational effectiveness analysis (Project Guardian) identified the highest payoff sensors and countermeasures to focus the Hit Avoidance (HA) Advanced Technology Demonstration (ATD). The HA ATD will be completed in FY97 with emphasis on the rapid transfer of survivability technologies to current systems (i.e., Abrams tank and Bradley fighting vehicle). The ATDs will demonstrate technical feasibility and develop system specifications for a low cost, active protection system for the physical disruption of non-gun tube fired, horizontal attack, hit-to-kill, chemical energy (CE) threat munitions and transfer hardware/software of a commander's decision aid (CDA) to engineering development for current systems. The CDA will provide the "brains" to interpret and fuse sensor input data, select and activate appropriate countermeasures, manage expendable inventory and increase situational awareness. This project will also develop and field tested a Congressionally directed vehicle self-protection system capable of close-in detection of high velocity, low front end radar cross-section kinetic energy (KE) threat munitions. This project will provide hardware performance and modeling predictions for a cost effective, operationally optimal suite of threat sensors and countermeasure devices. Coupled with other combat vehicles assets, force protection and increased situational awareness capabilities could then be realized. This enhanced vehicle survivability will extend the fighting life of the vehicle and result in a force multiplying effect and greater life cycle savings for the vehicle fleet. Survivability technologies that are integrated and demonstrated under this project include those transitioned from the following exploratory developmental programs; active protection countermeasure technology development PE 0601102A (Defense Research Sciences)/ Project AH43 and BH57; sensors and countermeasures PE 0602270A (Electronic Warfare Technology)/ Project A442. This project also supports a classified program. Major contractors include: United Defense LP. of San Jose (prime), CA; Sanders, a Lockheed Martin Company in Nashua, NH.; TRW of Redondo Beach, CA.; Dynetics, Inc. in Huntsville, AL; Hughes Danbury, Danbury Conn.; Chang Industries, LaVerne, CA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4717 - Optimized design and initiated fabrication of low cost active protection concept for protection against smart, horizontal attack, chemical energy (CE) threat munitions based on component field test evaluations of radar sensor, countermeasure options, and countermeasure launcher.             <ul style="list-style-type: none"> <li>- Awarded a competitive contract for the development, testing and analysis of an armored vehicle self-protection system capable of close in detection and destruction of high velocity, low front-end radar cross section KE rounds as directed by Congress.</li> <li>- Completed the development and acquisition of sensor and countermeasure emulators for the evaluation of the CDA.</li> </ul> </li> <li>• 3666 - Developed and integrated sensor fusion algorithms for threat identification and location into a commander's decision aid for automation of crew responses.             <ul style="list-style-type: none"> <li>- Performed cost effectiveness analysis to determine optimal survivability suite approach for the ground combat vehicle fleet through joint User evaluation.</li> </ul> </li> <li>• 2970 - Classified program support.</li> </ul> |                   |                     |                     |   |                     |                     |                           |                               |                     |            |
| Project D221   |                   |                     | Page 2 of 12 Pages  |   |                     |                     | Exhibit R-2 (PE 0603005A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|--------------------------|-------|------|-----|-----|--------------------|-------|------|--|--|-----------------------------------|-------|--|--|--|--------------------------|-------|------|-----|-----|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b> | <b>PROJECT</b><br><b>D221</b> |                |                |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
| <p>Total 11353</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4003 - Perform field demonstration of a low cost active protection system to defeat non-gun tube fired, horizontal attack, hit-to-kill, chemical energy (CE) threat munitions, develop system specifications for this system and field test a self-protection system capable of close in detection of high velocity, low front-end radar cross-section kinetic energy (KE) threat munitions.</li> <li style="padding-left: 20px;">- Demonstrate the commander's decision aid and provide system specifications (including software in standard ADA code and necessary documentation for engineering and manufacturing development (EMD) application).</li> <li style="padding-left: 20px;">- Update operational effectiveness analysis to complete affordability assessment with validated threat sensor and countermeasure performance data.</li> <li style="padding-left: 20px;">- Transfer the CDA to PEO Ground Combat and Support Systems (GCSS) for engineering and manufacturing development (EMD).</li> <li>• 559 - Classified program support.</li> <li>• 97 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4659</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 690 - Classified program support.</li> </ul> <p>Total 690</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 690 - Classified program support.</li> </ul> <p>Total 690</p> |   |                               |                |                |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 15%; text-align: center;"><u>FY 1996</u></th> <th style="width: 15%; text-align: center;"><u>FY 1997</u></th> <th style="width: 15%; text-align: center;"><u>FY 1998</u></th> <th style="width: 15%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 97 President's Budget</td> <td style="text-align: right;">12090</td> <td style="text-align: right;">4758</td> <td style="text-align: right;">678</td> <td style="text-align: right;">675</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: right;">12429</td> <td style="text-align: right;">4659</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: right;">-1076</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: right;">11353</td> <td style="text-align: right;">4659</td> <td style="text-align: right;">690</td> <td style="text-align: right;">690</td> </tr> </tbody> </table>   |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 97 President's Budget | 12090 | 4758 | 678 | 675 | Appropriated Value | 12429 | 4659 |  |  | Adjustments to Appropriated Value | -1076 |  |  |  | FY 1998 Pres Bud Request | 11353 | 4659 | 690 | 690 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
| FY 97 President's Budget  | 12090   | 4758                          | 678            | 675            |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
| Appropriated Value  | 12429   | 4659                          |                |                |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
| Adjustments to Appropriated Value   | -1076   |                               |                |                |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
| FY 1998 Pres Bud Request  | 11353   | 4659                          | 690            | 690            |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |
| <p>Project D221 <span style="float: right;">Page 3 of 12 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0603005A)</span></p>  |   |                               |                |                |                |                |                |                          |       |      |     |     |                    |       |      |  |  |                                   |       |  |  |  |                          |       |      |     |     |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b> |                     |                     |                           |                              | PROJECT<br><b>D440</b> |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| D440 Advanced Combat Vehicle Technology  | 11527             | 13101               | 4256                | 20325  | 34162               | 38310               | 23258                     | 31104                        | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project demonstrates the operational potential, technical feasibility and maturity of advanced combat vehicle technologies for potential product improvements to currently fielded and next generation combat vehicles. The objectives are to demonstrate innovative combat vehicle configurations, technologies and integration techniques through Integrated Product and Process Development (IPPD) yielding hardware technology demonstrations, computer simulations and full-scale demonstrations, to accomplish a more rapid and seamless transition of advanced technologies to systems applications. All demonstrations include user and developer teaming in field and/or laboratory environments. This project concludes a major initiative, the Composite Armor Vehicle (CAV) ATD, which examines technologies applicable to lighter weight and more survivable systems that offer significantly improved deployability over currently fielded combat vehicles. 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. The CAV program acknowledges that any issues, such as automotive durability, ability to withstand weapon firing shock, manufacturing methods and technology, reparability, ballistic performance, and nondestructive testing, must to be resolved before composite technology can be transitioned to ground combat vehicle systems. Coordination with ground vehicle program managers (PMs) has resulted in active interest by PM Crusader in transitioning composite technology into the Crusader design. The Future Scout and Cavalry System (FSCS) ATD is another major initiative that transitions from applied research PE 0602601A (Combat Vehicle and Automotive Technology) to this project in FY98. This program will integrate advanced technologies, including sensors, signature management, survivability, advanced mobility technologies and communications in the selected scout platform. The FSCS ATD will then undergo technical and user evaluations. Potential exists for a joint program on the FSCS program and the United Kingdom's TRACER program. Other vehicles supported by this PE with advanced component concepts and technologies include Abrams tank upgrades, the M2/M3 Bradley and Crusader. United Defense, Limited Partnership, San Jose, CA is the prime contractor for the CAV ATD.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 10799 - Approved CAV final design; using advanced composite manufacturing techniques, fabricated one composite hull structure for the CAV ATD test vehicle.             <ul style="list-style-type: none"> <li>- Demonstrated and validated the composite hull interfaces of the CAV ATD hull sample sections for automotive, crew, and weapon station subsystems.</li> <li>- Using CAV composite technology, developed a turret design for the Crusader vehicle to enable composite material transition..</li> <li>- Performed a Battle Lab Warfighting Experiment (BLWE) with soldiers to verify battlefield reparability of composites.</li> </ul> </li> <li>• 728 - Integrated the scout sensor suite on surrogate Hunter vehicle and conducted automotive testing.</li> </ul> <p>Total 11527</p> |                   |                     |                     |  |                     |                     |                           |                              |                        |            |
| Project D440   |                   |                     | Page 4 of 12 Pages  |  |                     |                     | Exhibit R-2 (PE 0603005A) |                              |                        |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE  | PROJECT                      |
| <b>3 - Advanced Technology Development</b>                     | <b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b>  | <b>D440</b>                  |
| <b>FY 1997 Planned Program:</b>                                |  |                              |
| • 9507   | - Assemble all automotive components into composite hull to complete the CAV ATD test vehicle.<br>- Initiate and complete large caliber weapon firing test to confirm hull structural integrity during gun firing.<br>- Initiate and complete automotive performance test to validate the capability of the hull structure to perform over various terrains and obstacles.<br>- Fabricate second composite hull structure for ballistic and durability testing.                      |                              |
| • 3330   | - Initiate 6000 mile durability test to validate the capability of the CAV structure to withstand combat vehicle life cycle fatigue loads and determine the structure's reliability.<br>- Initiate and complete a composite design guide for use by combat vehicle designers.<br>- Develop and release FSCS ATD request for proposal.  |                              |
| • 264  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                              |
| Total  | 13101  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 1500   | - Complete CAV 6000 mile durability testing, final report and close contract.  |                              |
| • 2756   | - Develop concepts and analysis in support of the Training and Doctrine Command (TRADOC) Integrated Concept Team (ICT) FSCS requirements development and transition results to the winning contractors.<br>- Evaluate proposals and award contract for FSCS ATD.<br>- Contractor will develop and allocate FSCS ATD design tradeoffs down to subsystems and initiate FSCS preliminary design.  |                              |
| Total  | 4256   |                              |
| <b>FY 1999 Planned Program:</b>                                |  |                              |
| • 7577   | - Transition vehicle electronics (VETRONICS) open systems architecture (VOSA) to the FSCS ATD contractor(s).<br>- Implementation of VOSA into the FSCS ATD design by the contractor(s).<br>- Initiate development of electronic interfaces between major subsystems of FSCS (e.g., target acquisition, communication, crew control and displays, etc.) by contractor(s).   |                              |
| • 12748  | - Complete contractor(s) preliminary design and interface control for FSCS ATD effort and initiate detail design.<br>- Contractor(s) develop manufacturing concepts, vehicle concepts and tools for engineering models for the FSCS ATD.<br>- Contractor(s) incorporate sensor suite, crew station, and electronic interface into contractor(s) design/systems integration laboratory (SIL) for FSCS ATD.<br>- Contractor(s) initiate development of FSCS ATD hardware and software. |                              |
| Total  | 20325  |                              |
| Project D440   | <i>Page 5 of 12 Pages</i>  | Exhibit R-2 (PE 0603005A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|--------------------------|-------|-------|------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|-------|-------|------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b> | <b>PROJECT</b><br><b>D440</b> |                |                |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 97 President's Budget</td> <td style="text-align: center;">11777</td> <td style="text-align: center;">13507</td> <td style="text-align: center;">2757</td> <td style="text-align: center;">20896</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">12109</td> <td style="text-align: center;">13101</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-582</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">11527</td> <td style="text-align: center;">13101</td> <td style="text-align: center;">4256</td> <td style="text-align: center;">20325</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1998 Funding increased (+1499) to complete testing of Composite Armored Vehicle.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 97 President's Budget | 11777 | 13507 | 2757 | 20896 | Appropriated Value | 12109 | 13101 |  |  | Adjustments to Appropriated Value | -582 |  |  |  | FY 1998 Pres Bud Request | 11527 | 13101 | 4256 | 20325 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |
| FY 97 President's Budget  | 11777   | 13507                         | 2757           | 20896          |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |
| Appropriated Value  | 12109   | 13101                         |                |                |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |
| Adjustments to Appropriated Value   | -582  |                               |                |                |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |
| FY 1998 Pres Bud Request  | 11527   | 13101                         | 4256           | 20325          |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |
| Project D440  | Page 6 of 12 Pages  | Exhibit R-2 (PE 0603005A)     |                |                |                |                |                |                          |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |       |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive</b><br><b>Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D441</b> |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D441 Combat Vehicle Mobility Technology  | 2516              | 4115                | 2949                | 4816  | 3350                | 4700                | 10500                     | 12673                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project demonstrates mobility technologies (suspension , track, engines, transmissions, and auxiliaries) vital for lighter, more agile, more deployable ground combat vehicles. It funds an advanced mobility technology demonstration comprised of several independent demonstrations. The principal elements of the mobility demonstration are semi-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, (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) a need for armor and signature management, which 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 the doctrine. The lighter and smaller vehicles are necessary for enhancing deployability and lessening the logistics burden (fuel), but such vehicles will significantly degrade ride performance and mobility limits compared to larger, heavier vehicles without new mobility technology advances. For the next decade, the mobility thrusts required to compensate for smaller and lighter systems are: electric drive (small internal propulsion size and weight), active suspension (increased vehicle stability and higher speed on rough terrain), compact efficient transmissions and light weight track (reduced system weight and track noise). Electric drive offers unique new capabilities, such as high torque and quiet operation; however, it presents new challenges, especially in cooling of electronic components. In-house efforts are accomplished by the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Other government agencies include: Waterways Experiment Station, Vicksburg, MS; Army Research Laboratory, Adelphi MD. Major contractors include: General Dynamics Land Systems Muskegon Operations, Muskegon, MI; Pentastar Huntsville, AL; United Defense Limited Partnership, San Jose, CA; Michigan Technological University, Houghton MI; General Electric, Schenectady, NY; Cadillac Gage Textron, New Orleans, LA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1205 - Initiated joint cooperative program (Army, USMC, DARPA) for integrated electric drive for tracked combat vehicles.             <ul style="list-style-type: none"> <li>- Procured semi-active suspension 30 ton weight class combat vehicle.</li> <li>- Developed single wheel HMMWV suspension test rig for control evaluation.</li> </ul> </li> <li>• 1311 - Performed experimental evaluation on advanced band track configurations.             <ul style="list-style-type: none"> <li>- Performed an analysis of high power density propulsion packaging for heavy combat vehicles.</li> <li>- Conducted mobility analysis of vehicle concepts that have electric drive, advanced suspension, and advanced track components.</li> </ul> </li> </ul> <p>Total 2516</p> |                   |                     |                     |   |                     |                     |                           |                               |                     |            |
| Project D441   |                   |                     | Page 7 of 12 Pages  |   |                     |                     | Exhibit R-2 (PE 0603005A) |                               |                     |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |   | DATE<br><b>February 1997</b>  |                           |                |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>                                       | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b>   | <b>PROJECT</b><br><b>D441</b> |                           |                |
| <b>FY 1997 Planned Program:</b>  |   |                               |                           |                |
| • 1563   | - Evaluate cooling systems for electric drive electronics.<br>- Test 30 ton weight class combat vehicle semi-active suspension in test vehicle.   |                               |                           |                |
| • 1085   | - Evaluate band track system application at increased vehicle weight.<br>- Analyze and compare study results of high power density propulsion system concepts for heavy combat vehicles.  |                               |                           |                |
| • 1400   | - In coordination with DARPA, demonstrate 30 ton weight class combat vehicle electric drive system.<br>- Develop compact high efficiency mechanical transmission  |                               |                           |                |
| • 67   | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                               |                           |                |
| Total  | 4115  |                               |                           |                |
| <b>FY 1998 Planned Program:</b>  |   |                               |                           |                |
| • 1128   | - In coordination with DARPA, test and evaluate electric drive and advanced mobility components on a 30 ton test bed.   |                               |                           |                |
| • 1821   | - Develop and evaluate active suspension preview sensor and algorithms.<br>- Develop track tensioning system for Future Scout and Cavalry System application.<br>- Develop semiactive suspension for Future Scout and Cavalry System.<br>- Test compact high efficiency mechanical transmission |                               |                           |                |
| Total  | 2949  |                               |                           |                |
| <b>FY 1999 Planned Program:</b>  |   |                               |                           |                |
| • 2800   | - Demonstrate band track system on 22 ton weight class combat vehicle.<br>- Demonstrate track and suspension system for Future Scout and Cavalry System   |                               |                           |                |
| • 2016   | - Test and evaluate silicon carbide (SiC)-based power electronic switches for motor drive controllers.<br>- Develop active suspension system using advanced subsystem technology.   |                               |                           |                |
| Total  | 4816  |                               |                           |                |
| <b>B. Project Change Summary</b>   |   |                               |                           |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u>            | <u>FY 1999</u> |
| FY 97 President's Budget   | 2565  | 4203                          | 3821                      | 4818           |
| Appropriated Value   | 2637  | 4115                          |                           |                |
| Adjustments to Appropriated Value  | -121  |                               |                           |                |
| FY 1998 Pres Bud Request   | 2516  | 4115                          | 2949                      | 4816           |
| Change Summary Explanation: Funding: FY 1998- Funding reprogrammed (-872) to higher priority requirements. |   |                               |                           |                |
| Project D441   | Page 8 of 12 Pages  |                               | Exhibit R-2 (PE 0603005A) |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive</b><br><b>Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D497</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D497 Combat Vehicle Electronics  | 967               | 1780                | 6174                | 7341  | 8571                | 9421                | 10752                     | 12963                        | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project develops and demonstrates the digital electronic 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 digitized battlefield. This project also funds improvements in ground vehicle soldier machine interfaces (SMI) by designing advanced crew station configurations for current combat vehicle upgrades and advanced vehicle designs with a 50% crew workload reduction. This project leverages technologies developed under the Crewman's Associate ATD for preliminary design of a FSCS crewstation and systems upgrades to Abrams, Bradley, and other ground combat vehicles. Laboratory experiments are used to allow the user to continuously influence and evaluate the capabilities of the crew station design and to refine overall system requirements prior to building more extensive hardware prototypes and vehicles. This interactive crew station design work ensures that future crew stations are designed to optimize the interface for the warfighter, allowing him to take maximum advantage of the digitized battlefield, not be overburdened by it. This project funds the development of the next generation of VETRONICS open systems architecture (VOSA) and provides an evolvable ground vehicle architecture/software baseline that will enable continuing software reuse. This will be a nonproprietary open systems electronics integration architecture based on commercially available standards and components. It will provide an initial harmonized architecture baseline with the UK for the FSCS ATD. It will then build on the FSCS ATD architecture to provide an advanced architecture baseline for the FSCS EMD and other ground vehicle programs. This architecture improves upon the current state-of-the-art ground vehicle integration architectures providing a 50% reduction in the cost per developed source line of software code while gaining a 10X improvement in system performance per hardware module. This architecture is critical to the integration of advanced sensors and countermeasures, advanced target acquisition technologies and digital communications into modern combat vehicles and is critical to the soldier's effective use of these technologies. Both the crew station work and VOSA are required to support Program Executive Office Ground Combat and Support Systems (PEO GCSS) preplanned product improvement (P3I) opportunities for the existing fleet (e.g., Abrams, Bradley), contribute to Crusader development, and support other vehicle development programs such as the FSCS ATD and Future Combat System.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 967 - Conducted laboratory experiments/battlelab warfighting experiments (BLWEs) to demonstrate an improved SMI for an upgrade to the Abrams tank and an advanced two-man crew station (50% workload reduction).<br/>- Completed Crewman's Associate Final Test/Design Report; Crewman's Associate ATD completed. Advances include: A 65% decrease in the workload required to send C2 messages, improved situational awareness, improved operations on the move, a user-friendly interface to the digital battlefield of Force XXI, improved night operations, reduced maneuver damage, improved continuous operations (CONOPs).</li> </ul> <p>Total 967</p> |                   |                     |                     |   |                     |                     |                           |                              |                               |            |
| Project D497   |                   |                     | Page 9 of 12 Pages  |   |                     |                     | Exhibit R-2 (PE 0603005A) |                              |                               |            |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)  |   | DATE<br>February 1997     |
|--|---|---------------------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  | PE NUMBER AND TITLE<br><b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b>  | PROJECT<br><b>D497</b>    |
| <b>FY 1997 Planned Program:</b>  |   |                           |
| <ul style="list-style-type: none"> <li>• 1043</li> <li>• 730</li> <li>• 7</li> <li>Total 1780</li> </ul> | <ul style="list-style-type: none"> <li>- Define US/UK harmonized electronic architecture baseline for the FSCS ATD.</li> <li>- Develop FSCS software architecture application program interface (API) reuse and performance baseline.</li> <li>- Modify VOSA software baseline to optimize the use of the latest version of the ADA programming language (ADA 95).</li> <li>- Development of hierarchy of hardware and software technical reference models to enable reuse and simplify open systems integration.</li> <li>- Define US/UK harmonized FSCS crew task list.</li> <li>- Define FSCS ATD crew station simulator design.</li> <li>- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> |                           |
| <b>FY 1998 Planned Program:</b>  |   |                           |
| <ul style="list-style-type: none"> <li>• 3374</li> <li>• 2800</li> <li>Total 6174</li> </ul>             | <ul style="list-style-type: none"> <li>- Evaluate FSCS ATD electronics architecture concepts.</li> <li>- Enhance and provide contractor 30% of the software for FSCS ATD as reuse modules.</li> <li>- Demonstrate VOSA, ADA 95 optimized, software architecture in the TARDEC system integration laboratory (SIL).</li> <li>- Define VOSA enhancements based on FSCS ATD contractor selections.</li> <li>- Evaluate FSCS ATD contractor crew station concepts.</li> <li>- Demonstrate FSCS crew task list baseline for user evaluation.</li> <li>- Provide 40% of crew station simulation software to FSCS ATDs as reuse.</li> </ul>  |                           |
| <b>FY 1999 Planned Program:</b>  |   |                           |
| <ul style="list-style-type: none"> <li>• 4206</li> <li>• 3135</li> <li>Total 7341</li> </ul>             | <ul style="list-style-type: none"> <li>- Optimize competing contractors FSCS ATD electronic architectures.</li> <li>- Define ground vehicle domain electronics architecture.</li> <li>- Define optimized electronic architecture for FSCS EMD initiation.</li> <li>- Begin fabrication of a ground vehicle domain electronic architecture SIL.</li> <li>- Define optimized FSCS crew station design and simulation.</li> <li>- Design FSCS crew station advanced decision aids and light weight helmet mounted display (HMD) for technology demonstration.</li> <li>- Modify FSCS crew station simulator for advanced functionality demonstration and user evaluation.</li> </ul>   |                           |
| Project D497   | Page 10 of 12 Pages   | Exhibit R-2 (PE 0603005A) |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                           |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive<br/>Advanced Technology</b> | <b>PROJECT</b><br><b>D497</b> |                |                           |
| <br><b>B. <u>Project Change Summary</u></b>   |   |                               |                |                           |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u>            |
| FY 97 President's Budget  | 969   | 5818                          | 6181           | 7354                      |
| Appropriated Value  | 996   | 1780                          |                |                           |
| Adjustments to Appropriated Value   | -29   |                               |                |                           |
| FY 1998 Pres Bud Request  | 967   | 1780                          | 6174           | 7341                      |
| <br>Change Summary Explanation: Funding: FY 1997- Funding reduced by Congress (-4038) for vehicle electronics hardware and software for generic future systems. |   |                               |                |                           |
|   |   |                               |                |                           |
| Project D497  |   | Page 11 of 12 Pages           |                | Exhibit R-2 (PE 0603005A) |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|--------------------------|---|---|---|---|--------------------|---|------|--|--|-----------------------------------|---|--|--|--|--------------------------|---|------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603005A Combat Vehicle and Automotive</b><br><b>Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D502</b> |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| D502 HAECO II   | 0                 | 1958                | 0                   | 0   | 0                   | 0                   | 0                         | 0                             | 0                   | 1958       |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| <p><b>A. <u>Mission Description and Budget Item Justification:</u></b> This Congressionally-directed project, originally funded in FY95 and funded again in FY97, calls for the further continued development and Army testing of the combined diesel/turbine engine program. The Army has contracted with the Hope-Anderson Engine Company (HAECO) to complete development of two engines in the 400 to 600 horsepower range for delivery to the Army for testing at the U.S. Army Tank-Automotive and Armaments Command. The contractor is HAECO Partners Ltd., Hillsboro, Ohio.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1910 - Test two end cylinders of an eight cylinder engine to improve scavenging and optimize the division of combustion and internal cooling air flow. Once a satisfactory design is achieved, reconfigure the design and fabricate parts for the upgraded final engine configuration. Test the new multicylinder engine with the objective to demonstrate 600 horsepower.</li> <li>• 48 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1958</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1996</u></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> <tr> <td>FY 97 President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1958</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">0</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1958</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997-Funding provided by Congress (+1958) to conduct testing of the combined diesel/turbine engine program.</p> |                   |                     |                     |   |                     |                     |                           |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 97 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value | 0 | 1958 |  |  | Adjustments to Appropriated Value | 0 |  |  |  | FY 1998 Pres Bud Request | 0 | 1958 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                               |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| FY 97 President's Budget  | 0                 | 0                   | 0                   | 0   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| Appropriated Value  | 0                 | 1958                |                     |   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| Adjustments to Appropriated Value   | 0                 |                     |                     |   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| FY 1998 Pres Bud Request  | 0                 | 1958                | 0                   | 0   |                     |                     |                           |                               |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |
| Project D502  |                   |                     | Page 12 of 12 Pages |   |                     |                     | Exhibit R-2 (PE 0603005A) |                               |                     |            |  |                |                |                |                |                          |   |   |   |   |                    |   |      |  |  |                                   |   |  |  |  |                          |   |      |   |   |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> |
|--|---|

| <i>COST (In Thousands)</i>              | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| Total Program Element (PE) Cost         | 29323          | 29379            | 19688            | 20911            | 19328            | 18707            | 22248            | 22852            | Continuing       | Continuing |
| D247 Tactical C4 Technology Integration | 5245           | 7271             | 8028             | 12824            | 10422            | 9665             | 12153            | 13023            | Continuing       | Continuing |
| D257 Digital Battlefield Communications | 12224          | 11620            | 8645             | 5365             | 4768             | 4827             | 5794             | 5431             | Continuing       | Continuing |
| D592 Space Applications Technology      | 5216           | 3635             | 3015             | 2722             | 4138             | 4215             | 4301             | 4398             | Continuing       | Continuing |
| D596 Field Laser Radar Demo             | 2844           | 4895             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 7739       |
| D597 Wave Net Technology                | 3794           | 1958             | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 5752       |

**Mission Description and Budget Item Justification:** This program element consists of projects that will advance command, control, and communications (C3) technology to provide the soldier with high quality real-time battlefield information and integrate space technologies into Army tactical applications. The tactical C4 technology integration project provides software application development demonstrations, communications system integration and prototype products for distributed, mobile, secure, fully automated spread spectrum radio networks with measures to enhance the survivability, 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. Work in this PE will provide multimedia inter networked 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 Defense Advanced Research Projects Agency (DARPA) and the Air Force (AF). The Digital Battlefield Communications project will support the Army's battlefield digitization effort by demonstrating technology to integrate communications hardware and software capable of providing seamless communications for the digitized battlefield to meet emerging requirements for high-capacity/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 space technology integration. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this program element is related to and fully coordinated with efforts in PE 0602782A (Command, Control and Communications Technology), PE 0203740A (Maneuver Control System), PE 0203726A (Advanced Field Artillery Tactical Data System), PE 0602783A (Computer and Software Technology), PE 0602702E (Tactical Technology), PE 0603772A

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b> |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  | PE NUMBER AND TITLE<br><b>0603006A Command, Control and Communications Advanced Technology</b> |                              |
| <p>(Advanced Tactical Computer Science and Sensor 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 Booz-Allen and Hamilton, Eatontown, NJ; AT&amp;T, Holmdel, NJ; GTE, Taunton, MA; 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.</p> |  |                              |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D247</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D247 Tactical C4 Technology Integration  | 5245              | 7271                | 8028                | 12824   | 10422               | 9665                | 12153                     | 13023                        | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project develops computer and communications technology options using commercial standard hardware and software to support battlefield decision making for the five battlefield functional areas. These efforts support evolving Army requirements for automated, real-time, digital information transfer, and the development and demonstration of communication 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 radios (CNR) technology 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 Defense Advanced Research Projects Agency (DARPA).</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2490 - Developed direct broadcast system capability as part of a joint program to demonstrate the potential applications for using the technology with standard Ku-band satellites and ground segments.             <ul style="list-style-type: none"> <li>- Investigated the feasibility and benefits of a terrestrial personal communications systems (PCS) by demonstrating the capability with legacy systems, mobile subscriber equipment for Task Force XXI.</li> <li>- Developed and demonstrated surrogate digital radio (SDR) technology during TF XXI to determine the effectiveness of passing high-volume digital traffic through a network in a battlefield situation.</li> <li>- Demonstrated internet protocol (IP) tactical end to end encryption devices (TEED), in support of field exercises.</li> <li>- Demonstrated autonomous battlefield satellite PCS capability.</li> <li>- Integrated ATM into legacy communication systems.</li> </ul> </li> <li>• 2755 - Continued development of Speakeasy Phase 2 MBMMR engineering prototypes and test modifications to software/hardware for adequate emulation of waveforms.</li> </ul> <p>Total 5245</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4364 - Develop and demonstrate on-the-move surrogate direct broadcast satellite (DBS) capability that will provide DBS-like capability to areas and situations without regard to satellite access limitations for both stationary and moving platforms.             <ul style="list-style-type: none"> <li>- Develop technology options for military use of commercial personal communication systems (PCS) technology for wireless access into the Army's mobile subscriber equipment (MSE).</li> <li>- Conduct field tests of the wideband packet surrogate digital radio in the task force (TF) XXI advanced warfighting experiment (AWE).</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                               |            |
| Project D247   |                   |                     | Page 3 of 14 Pages  |   |                     |                     | Exhibit R-2 (PE 0603006A) |                              |                               |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> | <b>PROJECT</b><br><b>D247</b> |
| <p><b>FY 1997 Planned Program (continued)</b></p> <ul style="list-style-type: none"> <li>- Conduct communication experiments with other services over the defense information systems network (DISN)/ leading edge services (LES) interconnection.</li> <li>- Develop an initial prototype of a conformal phased array antenna for radio access point communications on-the-move requirements.</li> <li>- Develop and demonstrate legacy modifications to allow legacy SATCOM terminals to use CECOM's airborne relay as a surrogate satellite to overcome limitations of satellite availability for tactical users.</li> </ul> <ul style="list-style-type: none"> <li>• 2750 - Continue the Speakeasy development of an open system architecture for a software reprogrammable simultaneous four-channel multiband multimode radio (MBMMR) which allows rapid change over of wave forms, frequency bands (2-2000 MHz), internetworking protocols (cross channel), voice/data modes, and information security (INFOSEC) algorithms, leading to an Army demonstration in a tactical vehicle configuration.</li> <li>• 157 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</li> </ul> <p>Total 7271</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2850 -Perform a field demonstration of the year-2 Advanced Development Model (ADM) Speakeasy Multiband Multimode Radio. Complete design, software coding, and fabrication on year-3 ADMs to reduce size, weight, power consumption and increase functionality.</li> <li>• 3000 -Continue lab experimentation with the other Services by exercising the Defense Information Systems Network (DISN)/Leading Edge Service (LES) interconnection to evaluate interconnection of tactical ATM with fixed ATM.<br/>Complete development of an integrated phased array antenna for radio access point communications OTM requirements.</li> <li>• 2178 Integrate and demonstrate end-to-end SHF surrogate satellite capability for range extension. Begin SATCOM terminal enhancements to reduce size and weight increasing throughput and mobility. Start UAV-based battlefield paging development.</li> </ul> <p>Total 8028</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3350 - Complete the Speakeasy development of an open system architecture for a software-reprogrammable simultaneous four-channel multiband multi-waveform which allows rapid changeover of waveforms, frequency bands (2-2000 Mhz), inter-networking protocols (cross-channel), voice/data modes, and INFOSEC algorithms (four-channel). Demonstrate radio in a tactical vehicle configuration.</li> <li>• 2820 - Continue DISN/LES interconnection experiments to evaluate emerging multi-service communication architectures.<br/>- Demonstrate appropriate digital battlefield communications (DBC) advanced technology demonstration (ATD) technologies in CORPS XXI AWE in support of high-capacity digitized communications and split-based operations. Demonstrate all the DBC ATD technologies in joint warfighter interoperability demonstration (JWID) 99.</li> <li>• 2350 - Demonstrate integrated phased array antenna for radio access point communications on-the-move (OTM) requirements.</li> </ul> |   |                               |
| Project D247  | Page 4 of 14 Pages  | Exhibit R-2 (PE 0603006A)     |

| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b> |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
|---|--|------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|-------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|-------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   | PE NUMBER AND TITLE<br><b>0603006A Command, Control and Communications Advanced Technology</b> |                              |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
|   |  | PROJECT<br><b>D247</b>       |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 4304 - Demonstrate UAV-based battlefield paging. Complete and demonstrate SHF SATCOM terminal enhancements. Fully integrate and demonstrate end-to-end UAV based surrogate satellite capability.</li> </ul> <p>Total 12824</p>  |  |                              |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5362</td> <td style="text-align: center;">7427</td> <td style="text-align: center;">8043</td> <td style="text-align: center;">12862</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5570</td> <td style="text-align: center;">7271</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-325</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">5245</td> <td style="text-align: center;">7271</td> <td style="text-align: center;">8028</td> <td style="text-align: center;">12824</td> </tr> </tbody> </table> |  |                              |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5362 | 7427 | 8043 | 12862 | Appropriated Value | 5570 | 7271 |  |  | Adjustments to Appropriated Value | -325 |  |  |  | FY 1998 Pres Bud Request | 5245 | 7271 | 8028 | 12824 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>               | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| FY 1997 President's Budget  | 5362   | 7427                         | 8043           | 12862          |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Appropriated Value  | 5570   | 7271                         |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| Adjustments to Appropriated Value   | -325   |                              |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| FY 1998 Pres Bud Request  | 5245   | 7271                         | 8028           | 12824          |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |
| <p>Project D247 <span style="float: right;">Page 5 of 14 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0603006A)</span></p>  |  |                              |                |                |                |                |                |                            |      |      |      |       |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |       |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603006A Command, Control and Communications Advanced Technology</b> |                     |                     |                           |                              | PROJECT<br><b>D257</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| D257 Digital Battlefield Communications  | 12224             | 11620               | 8645                | 5365   | 4768                | 4827                | 5794                      | 5431                         | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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. 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2615 - Began integration of ATM service into legacy communications network.</li> <li>• 1912 - Completed functional definition of RAP.             <ul style="list-style-type: none"> <li>- Determined emerging satellite technologies that will be required to use the tactical multi-net gateway (TMG) as an interface into the Tactical Internet as described in the Tactical Internetwork System Description.</li> </ul> </li> <li>• 2690 - Completed commercial off the shelf (COTS) testing/requirements definition for high capacity trunk radio (HCTR).             <ul style="list-style-type: none"> <li>- Began analysis of criteria imposed by the supported ground segment (HCTR/RAP antenna) and available platforms.</li> <li>- Continued modeling and simulation of battlefield information transmission system (BITS) technologies.</li> </ul> </li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                        |            |
| Project D257   |                   |                     | Page 6 of 14 Pages  |  |                     |                     | Exhibit R-2 (PE 0603006A) |                              |                        |            |

DATE  
**February 1997**

BUDGET ACTIVITY  
**3 - Advanced Technology Development**

PE NUMBER AND TITLE  
**0603006A Command, Control and Communications Advanced Technology**

- Completed demonstration of low profile OTM antennas.

**FY 1996 Accomplishments: (continued)**

- 3007 - Began experimentation with wideband airborne communications relays and satellite personal communications services (PCS).  
- Demonstrated direct broadcast video for tactical applications.  
- Integrated field models of the surrogate digital radio (SDR) into a brigade in conjunction with the task force (TF) XXI advanced warfighting experiment (AWE).  
- Implemented TEED into Digital Battlefield Communications architecture to provide security technology for multi level security (MLS) requirements.  
- Evaluated hardware in the Digital Integrated Laboratory (DIL) to ready for TF XXI exercise.
- 2000 - Inserted and integrated emerging communications technologies in TF XXI. Provided technical/engineering support and on-site field support for TF XXI encompassing necessary coordination of AWE systems.

Total 12224

**FY 1997 Planned Program:**

- 2850 - Demonstrate military-unique ATM enhancements (i.e. adaptive forward error correction, ATM signaling over tactical circuits, ATM over wireless networks) over legacy communication systems (e.g. mobile subscriber equipment (MSE)) to allow for better use of available bandwidth. Support and conduct TF XXI AWE ATM multimedia experimentation.  
- Develop and demonstrate wireless subscriber access (e.g. commercial PCS, wireless ISDN, near term data radio, SDR) into the RAP.  
- Leverage commercial personal communications system (PCS) technology to create a terrestrial PCS that will use very small tactical transportable base stations enabling wireless access into MSE (tactical MSE interface to commercial standard hardware).  
- Continue experimentation of communications satellite PCS technology to determine responsiveness to Army needs.
- 3230 - Demonstrate radio access point (RAP) function, integrating mobile internet protocol, and survivable hand-off capability in a multi media laboratory demo using commercial standard (e.g. ATM, IP, narrowband integrated service digital network (ISDN) ) protocols.
- 3817 - Begin modification of commercial non developmental hardware for high capacity trunk radio (HCTR) demonstration.  
- Continue modeling and simulation support for RAP/HCTR development.  
- Demonstrate a wideband, point to point 45 mega bits per second (MBps) airborne communications relay package to link RAP/HCTR back to MSE/tri-service tactical communications system (TRITAC)/Army common user system (ACUS).  
- Develop an initial prototype of a conformal phased array antenna for radio access point communications on-the-move requirements.
- 1439 - Conduct user tests of DBC ATD products in TF XXI AWE and other user demonstrations.  
- Conduct experimentation of the wideband packet surrogate digital radio (SDR) in the TF XXI AWE.  
- Continue experimentation and support of tactical end-to-end encryption device security requirements for the DBC ATD and TF XXI.
- 284 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE  | PROJECT                      |
| <b>3 - Advanced Technology Development</b>                     | <b>0603006A Command, Control and Communications Advanced Technology</b>  | <b>D257</b>                  |
| Total  | 11620  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| •  | 1785 - Complete ATM multimedia experimentation. Demonstrate ATM/MSE voice, low rate survivable ATM protocols, adaptive forward error correction (FEC), and support for ATM signaling in a tactical environment.<br>- Complete evaluation and demonstrate commercial terrestrial PCS to exploit commercial technology for MSE access. Begin PCS range extension enhancement.  |                              |
| •  | 2856 - Integrate the RAP prototype into the digital integrated laboratory to demonstrate connectivity with MSE TPN and enhanced position location reporting system (EPLRS) in a static environment.<br>- Integrate Real Time Internet Protocol (IP) with mobile IP for TMG/ATM to support RAP with low bit rate video teleconferencing.  |                              |
| •  | 2450 - Complete modification of commercial off the shelf (COTS) NDI hardware for high capacity trunk radio integration and demonstration.<br>- Initiate development of a dual band (X-band and Ku-band) airborne communications relay package capable of supporting 155 Mbps communications.<br>- Complete development of an integrated phased array antenna for RAP communications on-the-move requirements.  |                              |
| •  | 1554 - Insert and evaluate DBC ATD products in DIV XXI AWE and other user demonstrations.<br>- Continue experimentation and support of tactical end-to-end encryption device (TEED) security requirements for the DBC ATD.<br>- Complete modeling and simulation tools for BITS product development.<br>- Begin DIL experimentation with Near Term Digital Radio (NTDR) in a ground field environment.<br>- Demonstrate narrowband high frequency communications technology with tactical internet access. |                              |
| Total  | 8645   |                              |
| <b>FY 1999 Planned Program:</b>                                |  |                              |
| •  | 1153 - Demonstrate ATM enhancements for high bandwidth trunks, such as survivable tactical ATM routing and virtual circuit identifier/ virtual path identifier (VCI/VPI) control, and provide support for mobile high bandwidth ATM networks.<br>- Demonstrate ATM integration into RAP.   |                              |
| •  | 1870 - Demonstrate mobile Radio Access Point (RAP). Integrate and demonstrate RAP with OTM HCTR and phased array antenna capable of mobile operation.  |                              |
| •  | 1040 - Integrate on-the-move (OTM) High Capacity Trunk Radio (HCTR) in the RAP.<br>- Complete DIL evaluation of the NTDR.  |                              |
| •  | 1302 - Demonstrate a dual band (X-band and Ku-band) airborne communications relay package capable of supporting 155-Mbps communications.<br>- Demonstrate mobile phased array antenna and PCS range extension enhancement.<br>- Insert and evaluate DBC ATD products in JWID 99 and other user demonstrations.   |                              |
| Project D257   | <i>Page 8 of 14 Pages</i>  | Exhibit R-2 (PE 0603006A)    |

| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|------|------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|-------|-------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> | <b>PROJECT</b><br><b>D257</b> |                |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Complete support of TEED security requirements for the DBC ATD.</li> <li>- Demonstrate wideband high frequency communications technology, with access to the tactical internet, for transmitting maneuver and intelligence data beyond line of sight for long range surveillance units.</li> </ul> <p>Total            5365</p>   |   |                               |                |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center; border-bottom: 1px solid black;"><u>FY 1996</u></th> <th style="text-align: center; border-bottom: 1px solid black;"><u>FY 1997</u></th> <th style="text-align: center; border-bottom: 1px solid black;"><u>FY 1998</u></th> <th style="text-align: center; border-bottom: 1px solid black;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: right;">10579</td> <td style="text-align: right;">11981</td> <td style="text-align: right;">8660</td> <td style="text-align: right;">5371</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: right;">10854</td> <td style="text-align: right;">11620</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: right;">1370</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: right;">12224</td> <td style="text-align: right;">11620</td> <td style="text-align: right;">8645</td> <td style="text-align: right;">5365</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY1996- Funding increase in project (+1645) reflects increased support for TF XXI AWE.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 10579 | 11981 | 8660 | 5371 | Appropriated Value | 10854 | 11620 |  |  | Adjustments to Appropriated Value | 1370 |  |  |  | FY 1998 Pres Bud Request | 12224 | 11620 | 8645 | 5365 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
| FY 1997 President's Budget  | 10579   | 11981                         | 8660           | 5371           |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
| Appropriated Value  | 10854   | 11620                         |                |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
| Adjustments to Appropriated Value   | 1370  |                               |                |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
| FY 1998 Pres Bud Request  | 12224   | 11620                         | 8645           | 5365           |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |
| Project D257  | Page 9 of 14 Pages  | Exhibit R-2 (PE 0603006A)     |                |                |                |                |                |                            |       |       |      |      |                    |       |       |  |  |                                   |      |  |  |  |                          |       |       |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D592</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D592 Space Applications Technology  | 5216              | 3635                | 3015                | 2722  | 4138                | 4215                | 4301                      | 4398                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> The objective of this project is to optimize Army utilization of space based systems. The project involves: (a) space technology development and demonstrations for evaluating technology feasibility, determining Army utility, and refining requirements, and (b) space technology integration into Battlefield Operating Systems. The project also addresses: defining Army requirements for space platforms; demonstrating advanced, compact space hardware; developing algorithms that optimally process space data; integrating satellite direct downlink to ground systems; and providing an advanced technology base for the Army Space Exploitation Demonstration Program, the Tri-Service DoD Space Test Program, and the exploitation of commercial space capabilities. The project focus is on Space Force Enhancement (communications, intelligence, position/navigation, reconnaissance, surveillance, target acquisition, weather/terrain, missile warning) to improve warfighting capabilities and operations other than war.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5216 - Demonstrated the solid-state laser boresight calibration system for space-based infrared (IR) sensors.</li> <li style="padding-left: 20px;">- Developed and tested the Acousto-Optical Tunable Filter (AOTF) IR sensor to provide multi/hyperspectral data from a space-based platform.</li> <li style="padding-left: 20px;">- Conducted feasibility study of alternative laser communication satellite-to-air-to-ground architectures.</li> <li style="padding-left: 20px;">- Completed study of utilizing planned commercial communication satellite systems to meet the Army's mobile communication requirements.</li> </ul> <p>Total 5216</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1095 - Demonstrate laser boresight calibration for space-based infrared (IR) sensors to improve joint tactical ground station (JTAGS) performance.</li> <li>• 710 - Develop low-altitude/high data rate laser communication ground terminal and conduct air-to-ground (mobile and fixed) lasercom demonstration.</li> <li>• 665 - Complete field test and demonstrate AOTF utility to provide spectral data from airborne platform.</li> <li>• 1080 - Develop Battlefield Ordnance Awareness plan, acquire target data, and evaluate C4I architecture.</li> <li>• 85 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3635</p> |                   |                     |                     |   |                     |                     |                           |                              |                               |            |
| Project D592  |                   |                     | Page 10 of 14 Pages |   |                     |                     | Exhibit R-2 (PE 0603006A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|---|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> | <b>PROJECT</b><br><b>D592</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 500 - Integrate laser boresight calibration capability into JTAGS system to include self-alignment and pointing.</li> <li>• 365 - Develop Ultraspectral Sensor technology for satellite and direct downlink applications.</li> <li>• 1150 - Demonstrate Battlefield Ordnance Awareness Concept on airborne platforms.</li> <li>• 1000 - Demonstrate satellite-to-ground laser communication.</li> </ul> <p>Total 3015</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 500 - Demonstrate and integrate satellite-to-satellite laser communications.</li> <li>• 1200 - Demonstrate the ability of the Battlefield Ordnance Awareness technology to identify explosive ordnance events on the battlefield and specify levels of conflict.</li> <li>• 1022 - Exploit commercial space products and capabilities that will enhance deep strike weapon systems, reduce sensor to shooter timelines, and improve the spatial registration of battlefield intelligence and targeting information.</li> </ul> <p>Total 2722</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2947</td> <td style="text-align: center;">3712</td> <td style="text-align: center;">2512</td> <td style="text-align: center;">2215</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5498</td> <td style="text-align: center;">3635</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-282</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">5216</td> <td style="text-align: center;">3635</td> <td style="text-align: center;">3015</td> <td style="text-align: center;">2722</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996- Funding (+2269k) increased by Congress for development and demonstration of missile warning, target acquisition and communications advanced space technologies.<br/> FY 1998/FY 1999 - Funding increased for the integration of missile warning and communications advanced space technologies into Battlefield Operating Systems.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2947 | 3712 | 2512 | 2215 | Appropriated Value | 5498 | 3635 |  |  | Adjustments to Appropriated Value | -282 |  |  |  | FY 1998 Pres Bud Request | 5216 | 3635 | 3015 | 2722 |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 2947  | 3712                          | 2512           | 2215           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 5498  | 3635                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -282  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 5216  | 3635                          | 3015           | 2722           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project D592  | Page 11 of 14 Pages   | Exhibit R-2 (PE 0603006A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                     | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> |                     |                     |                     |                              | <b>PROJECT</b><br><b>D596</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D596 Field Laser Radar Demo   | 2844              | 4895                | 0                   | 0   | 0                   | 0                   | 0                   | 0                            | 0                             | 7739       |
| <p><b>A. <u>Mission Description and Justification:</u></b> The objective of this Congressional special interest project is to provide data reduction and analysis of field experiments data to evaluate the utility of the Field Laser Radar for Army applications. The Field Laser Radar is an imaging carbon dioxide (CO<sub>2</sub>) laser radar (ladar). This ladar transmits a waveform capable of high resolution measurements in both range and velocity. Potential applications to be investigated include theater ballistic missile defense or cruise missile defense. In addition, the equipment can provide long range, coherent remote sensing of chemical warfare agents.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 690 -Conducted chemical warfare agent detection experiments.<br/>-Conducted static ground tests on cruise missiles.<br/>-Conducted flight tests of unpowered tactical air launched decoy.</li> <li>• 2154 -Developed algorithms and analyzed field data.<br/>-Analyzed helicopter installation requirements.<br/>-Developed hardware requirements for helicopter ladar.</li> </ul> <p>Total 2844</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1150 -Conduct chemical warfare agent detection experiments.<br/>-Conduct static ground tests on cruise missiles.<br/>-Conduct flight tests of unpowered tactical air launched decoy.</li> <li>• 3625 -Develop date products fusion and algorithms.<br/>-Analyze precision and active angle tracking.<br/>-Develop multi-dimensional image.</li> <li>• 120 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4895</p> <p><b>FY 1998 Planned Program:</b> Program not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p>Project D596</p> |                   |                     |                     |   |                     |                     |                     |                              |                               |            |

|  |                              |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> | <b>PROJECT</b><br><b>D596</b> |
|--|---|-------------------------------|

| <b><u>B. Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|---|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget              | 2918           | 0              | 0              | 0              |
| Appropriated Value                      | 3000           | 4895           |                |                |
| Adjustments to Appropriated Value       | -156           |                |                |                |
| FY 1998 Pres Bud Request                | 2844           | 4895           | 0              | 0              |

Change Summary Explanation: Funding: FY 1997- Funding provided by Congress (+4895k) to test the current hardware in a tactical environment

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|-------------------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|---|---|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603006A Command, Control and Communications Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D597</b> |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| D597 Wave Net Technology   | 3794              | 1958                | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                             | 5752       |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| <p><b>A. Mission Description and Justification:</b> The objective of this Congressional special interest project is to develop and evaluate a Wave Net circuit to perform image compression and decompression. Wave Net is an application-specific integrated circuit that utilizes a neural network architecture to efficiently perform low loss image compression. Potential applications include compression of imagery for battlefield situation awareness, aerial surveillance sensor downlinks, and image based target hand-off.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3794 - Performed simulations to verify throughput, fidelity, and error resiliency of the Wave Net architecture. Initiated development and testing of prototype Wave Net circuit card.</li> </ul> <p>Total 3794</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1910 - Complete development and testing of prototype wave net circuit card to investigate the potential of the algorithms to increase communications bandwidth utilization.</li> <li>• 48 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1958</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> |                   |                     |                     |   |                     |                     |                           |                              |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| <p><b>B. Project Change Summary</b></p> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td align="right">3794</td> <td align="right">0</td> <td align="right">0</td> <td align="right">0</td> </tr> <tr> <td>Appropriated Value</td> <td align="right">4000</td> <td align="right">1958</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td align="right">-206</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td align="right">3794</td> <td align="right">1958</td> <td align="right">0</td> <td align="right">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 funding provided by Congress (+1958) to develop and evaluate a Wave Net circuit to perform image compression and decompression.</p>   |                   |                     |                     |   |                     |                     |                           |                              |                               |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 3794 | 0 | 0 | 0 | Appropriated Value | 4000 | 1958 |  |  | Adjustments to Appropriated Value | -206 |  |  |  | FY 1998 Pres Bud Request | 3794 | 1958 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                              |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1997 President's Budget   | 3794              | 0                   | 0                   | 0   |                     |                     |                           |                              |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Appropriated Value   | 4000              | 1958                |                     |   |                     |                     |                           |                              |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Adjustments to Appropriated Value  | -206              |                     |                     |   |                     |                     |                           |                              |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1998 Pres Bud Request   | 3794              | 1958                | 0                   | 0   |                     |                     |                           |                              |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Project D597   |                   |                     | Page 14 of 14 Pages |   |                     |                     | Exhibit R-2 (PE 0603006A) |                              |                               |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |                     |  |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603007A Manpower, Personnel and Training</b><br><b>Advanced Technology</b> |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate  | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost   | 4576              | 4406                | 3003                | 3006                | 3001   | 2996                | 2991                | 2991                         | Continuing          | Continuing |
| A792 Manpower and Personnel   | 2148              | 1389                | 3003                | 3006                | 3001   | 2996                | 2991                | 2991                         | Continuing          | Continuing |
| A793 Training Systems and Education   | 2428              | 3017                | 0                   | 0                   | 0  | 0                   | 0                   | 0                            | 0                   | 5445       |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> The objective of this program is to demonstrate soldier-oriented technologies to enhance soldier and unit performance. Affordability goals include the reduction of personnel costs through improved career development and retention and the development of effective training strategies within a constrained resource environment. Research programs include developing knowledge and skills required for successful command on the increasingly digitized battlefield, training strategies using simulators and in distributed interactive simulation (DIS), and developing improved career progression procedures to meet the requirements of the 21st Century battlefield. 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 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). As a result of the HQDA Redesign, ARI's research program has undergone major restructuring.</p> |                   |                     |                     |                     |  |                     |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
|---|-------------------|---------------------|---------------------|--|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603007A Manpower, Personnel and Training</b><br><b>Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>A792</b> |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| A792 Manpower and Personnel   | 2148              | 1389                | 3003                | 3006   | 3001                | 2996                | 2991                      | 2991                          | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project demonstrates soldier-oriented technologies that will lead to improved Army personnel utilization. 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 to ensure that 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 in this program element is coordinated with the Training and Doctrine Command (TRADOC) Battle Laboratories, and demonstration projects are integrated into the Battle Labs' Advanced Warfighting Experiments. Beginning FY98, this project will include training research.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2148 - Developed improved soldier-job matching procedures by effectively utilizing psychomotor, spatial and temperament measures.               <ul style="list-style-type: none"> <li>- Refined Special Forces selection and assignment tests and procedures.</li> <li>- Provided preliminary findings on determinants of battle command performance and recommendations for decision aid evaluation methodologies to the Battle Command Battle Lab.</li> <li>- Developed methods for improving occupational analysis efficiency and accuracy.</li> <li>- Validated prototype techniques for developing and training practical thinking skills within tactical units.</li> <li>- Determined the relationship between individual soldier characteristics and performance in peacekeeping missions.</li> </ul> </li> </ul> <p>Total 2148</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1355 - Provide guidelines for harnessing available and projected information technologies to support effective battle command on the future digitized battlefield.               <ul style="list-style-type: none"> <li>- Demonstrate utility of Battle Commander development tools and techniques.</li> <li>- Develop peer and supervisory ratings of Special Forces leadership potential.</li> <li>- Provide findings on the post-deployment effects of peacekeeping on soldier and spouse marital stability, financial well-being, and commitment to the Army (active and reserves).</li> </ul> </li> <li>34 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 1389</p> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |
| Project A792  |                   |                     | Page 2 of 5 Pages   |  |                     |                     | Exhibit R-2 (PE 0603007A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |         |         |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
|---|---|------------------------------|---------|---------|---------|---------|---------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|------|------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   | PE NUMBER AND TITLE<br><b>0603007A Manpower, Personnel and Training<br/>Advanced Technology</b> |                              |         |         |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| PROJECT<br><b>A792</b>  |   |                              |         |         |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3003 - Assess effectiveness of compressed gunnery training strategies for Army National Guard.</li> <li style="padding-left: 20px;">- Provide information for update of Battalion Level Training Models based on research and development of structured training programs for the Close Combat Tactical Trainer (CCTT).</li> <li style="padding-left: 20px;">- Develop and demonstrate improved methods for writing training objectives and translating them into efficient exercise scenarios for joint fire support training.</li> </ul> <p>Total 3003</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3006 - Develop and demonstrate methods for planning and conducting systematic, vertical (multi-site, multi-Service, multi-echelon) after-action reviews for joint exercises in DIS (distributed interactive simulation).</li> <li style="padding-left: 20px;">- Assess effectiveness of prototype MOUT (military operations in urban terrain) training developed for rifle squad leaders in Dismounted Battlespace Battle Lab warfighting experiments.</li> <li style="padding-left: 20px;">- Develop and pre-test scenarios and role plays designed to help leaders assess, train, and develop team members of the Special Operations Forces.</li> </ul> <p>Total 3006</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;"></th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1996</th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1997</th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1998</th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1999</th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2204</td> <td style="text-align: center;">1418</td> <td style="text-align: center;">2035</td> <td style="text-align: center;">2482</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2265</td> <td style="text-align: center;">1389</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-117</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2148</td> <td style="text-align: center;">1389</td> <td style="text-align: center;">3003</td> <td style="text-align: center;">3006</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: Funds reprogrammed in FY1998 (+968) and FY1999 (+524) for restructure of training research to this project.</p> |   |                              |         | FY 1996 | FY 1997 | FY 1998 | FY 1999 | FY 1997 President's Budget | 2204 | 1418 | 2035 | 2482 | Appropriated Value | 2265 | 1389 |  |  | Adjustments to Appropriated Value | -117 |  |  |  | FY 1998 Pres Bud Request | 2148 | 1389 | 3003 | 3006 |
|   | FY 1996   | FY 1997                      | FY 1998 | FY 1999 |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget  | 2204  | 1418                         | 2035    | 2482    |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Appropriated Value  | 2265  | 1389                         |         |         |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value   | -117  |                              |         |         |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request  | 2148  | 1389                         | 3003    | 3006    |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |
| Project A792  | Page 3 of 5 Pages   | Exhibit R-2 (PE 0603007A)    |         |         |         |         |         |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |      |      |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603007A Manpower, Personnel and Training</b><br><b>Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>A793</b> |                     |            |
| COST (In Thousands)  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| A793 Training Systems and Education  | 2428              | 3017                | 0                   | 0  | 0                   | 0                   | 0                         | 0                             | 0                   | 5445       |
| <p><b>A. Mission Description and Justification:</b> The objective of this project is to demonstrate empirically-based cost-effective training strategies, with particular emphasis on 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 stability operations. This 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. Beginning in FY1998, this research is restructured to project A792.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2428 - Developed device-based tool for predicting tank gunnery performance for Reserve Component (RC). <ul style="list-style-type: none"> <li>- Validated prototype structured platoon-level training program for Close Combat Tactical Trainer (CCTT).</li> <li>- Developed database for relating training performance in SIMNET to performance at the Combat Training Centers.</li> <li>- Identified infantry unit training problems caused by transition from combat roles to peacekeeping/stability missions and back.</li> <li>- Designed a preliminary aviation training strategy with an emphasis on low-cost, part-task simulators and training devices.</li> <li>- Demonstrated the feasibility of natural language processing and authorable microworlds in computer-based language training for Arabic.</li> </ul> </li> </ul> <p>Total 2428</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2943 - Validate brigade-level and multi-service training strategies and performance assessment methodologies. <ul style="list-style-type: none"> <li>- Deliver recommendations for the frequency and sequencing of training for Combined Arms Tactical Trainer training management system.</li> <li>- Design prototype, structured company-level CCTT training program.</li> <li>- Design and test prototype aviation training strategies with alternative mixes of training devices/simulators/simulations and live training.</li> <li>- Develop RC training device-based tool (AFIST) for predicting live-fire tank gunnery performance.</li> </ul> </li> <li>74 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 3017</p> <p><b>FY 1998 Planned Program:</b> Program restructured to project A792.</p> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |
| Project A793   |                   |                     | Page 4 of 5 Pages   |  |                     |                     | Exhibit R-2 (PE 0603007A) |                               |                     |            |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603007A Manpower, Personnel and Training<br/>Advanced Technology</b> | <b>PROJECT</b><br><b>A793</b> |
|--|--|-------------------------------|

**FY 1999 Planned Program:** Program restructured to project A792.

|   |                |                |                |                |
|---|----------------|----------------|----------------|----------------|
| <b><u>B. Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget              | 2492           | 3082           | 3242           | 3764           |
| Appropriated Value                      | 2561           | 3017           |                |                |
| Adjustments to Appropriated Value       | -133           |                |                |                |
| FY 1998 Pres Bud Request                | 2428           | 3017           | 0              | 0              |

Change Summary Explanation: Funding: As a result of ARI restructuring, training research is reported in Project A792 beginning in FY1998.



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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603105A Military Human Immunodeficiency Virus (HIV) Research</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>DH29</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| DH29 Medical Protection Against HIV  | 2795              | 17544               | 2713                | 3162   | 3182                | 3157                | 3208                      | 3381                         | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description and Budget Item Justification:</u></b> This program element supports research to provide concept exploration of candidate prevention vaccines to include safety and efficacy in model systems to prepare and conduct clinical studies. It funds Congressionally directed Acquired Immune Deficiency Syndrome (AIDS) research to control the infection in military environments, 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; and vaccine development. Efforts are directed to answer militarily unique questions affecting manning, mobilization and deployment. This program is managed primarily by the US Army Medical Research and Materiel Command. The major contractor is Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, MD. This program is dedicated to conducting proof of principle demonstrations and tests of non-system specific technologies to meet specific military needs and is therefore correctly placed in Budget Activity 3.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1873 Characterized field sites for clinical trials of candidate vaccines.</li> <li>• 922 Evaluated safety and immunogenicity Phase I and Phase II of candidate vaccine.</li> </ul> <p>Total 2795</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1894 Continue field site preparation for candidate vaccine clinical trials.</li> <li>• 954 Complete safety and immunogenicity Phase I and Phase II trials of multiple candidate vaccines.</li> <li>• 7134 Congressional special interest. Conduct studies to develop a vaccine to prevent HIV including: characterize protective epitopes, evaluate vaccine candidates in animal models, identify cohorts for vaccine trials, develop and maintain international and domestic laboratories to support HIV trials, and assess the feasibility of a killed whole virus vaccine.</li> <li>• 1617 Congressional special interest. Conduct national and international surveillance of HIV genotypes and select the most promising strains for vaccine development.</li> <li>• 5516 Congressional special interest. Conduct studies on HIV specific immune reconstitution, natural history of HIV infection, role of cell receptors in infectivity and pathogenicity, and preliminary studies on rapid diagnosis of HIV infection.</li> <li>• 429 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 17544</p> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project DH29   |                   |                     | Page 1 of 2 Pages   |  |                     |                     | Exhibit R-2 (PE 0603105A) |                              |                               |            |

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|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|-------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|-------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603105A Military Human Immunodeficiency Virus (HIV) Research</b> | <b>PROJECT</b><br><b>DH29</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1153 Prepare field site for candidate vaccine clinical trials.</li> <li>• 858 Conduct safety and immunogenicity Phase I and Phase II trials of promising candidate vaccines.</li> <li>• 702 Analyze possible correlates of immunity of vaccines and controls that participated in these trials.</li> </ul> <p>Total 2713</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1352 Conduct field site preparation for candidate vaccine clinical trials.</li> <li>• 1009 Complete safety and immunogenicity Phase I and Phase II trials of candidate vaccines.</li> <li>• 801 Examine possible immune responses from these vaccine trials.</li> </ul> <p>Total 3162</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2866</td> <td style="text-align: center;">2919</td> <td style="text-align: center;">3047</td> <td style="text-align: center;">3207</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">2946</td> <td style="text-align: center;">17544</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-151</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2795</td> <td style="text-align: center;">17544</td> <td style="text-align: center;">2713</td> <td style="text-align: center;">3162</td> </tr> </tbody> </table> <p>Change Summary Explanation:<br/>           Funding: FY1997: Funding (14625) provided by Congressional action.<br/>           FY 1998: Funds reprogrammed (-334) to higher priority programs.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2866 | 2919 | 3047 | 3207 | Appropriated Value | 2946 | 17544 |  |  | Adjustments to Appropriated Value | -151 |  |  |  | FY 1998 Pres Bud Request | 2795 | 17544 | 2713 | 3162 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |      |      |
| FY 1997 President's Budget  | 2866   | 2919                          | 3047           | 3207           |                |                |                |                            |      |      |      |      |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |      |      |
| Appropriated Value  | 2946   | 17544                         |                |                |                |                |                |                            |      |      |      |      |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |      |      |
| Adjustments to Appropriated Value   | -151   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |      |      |
| FY 1998 Pres Bud Request  | 2795   | 17544                         | 2713           | 3162           |                |                |                |                            |      |      |      |      |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |      |      |
| Project DH29  | Page 2 of 2 Pages  | Exhibit R-2 (PE 0603105A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |       |  |  |                                   |      |  |  |  |                          |      |       |      |      |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603238A Air Defense/Precision Strike Technology</b> |
|--|---|

| COST ( <i>In Thousands</i> )    | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|---------------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| Total Program Element (PE) Cost | 37630             | 22009               | 11664               | 4926                | 18798               | 18029               | 17971               | 15819               | Continuing          | Continuing |
| D177 JT ALS PS Demo             | 33624             | 13997               | 6066                | 1473                | 18798               | 18029               | 17971               | 15819               | Continuing          | Continuing |
| D546 STARLOS                    | 4006              | 8012                | 5598                | 3453                | 0                   | 0                   | 0                   | 0                   | 0                   | 21069      |

**Mission Description and Budget Item Justification:** Overall Joint Precision Strike Demonstration (JPSD) program goals are to reduce sensor to shooter timelines from hours to minutes as well as to achieve quantifiable improvements in target location and identification, weapons systems responsiveness and kill capability, and accurate damage assessment through such techniques as near-real-time sensor cueing, near-real-time data dissemination, seamless sensor-to-shooter node communication, dynamic re-targeting, improved weapons system accuracy and precision guided munitions. This program provides for the integration of new, high-payoff technologies, architectural and operational concepts, along with existing and emerging systems to demonstrate enhanced precision strike and counterfire capabilities for targets at deep and extended ranges. The objective of the Joint Precision Strike Demonstration (JPSD) Precision/Rapid Counter Multiple Rocket Launcher (P/RC-MRL) Advanced Concept Technology Demonstration (ACTD) 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 conducts building block demonstrations to identify technical and operational barriers to an adverse weather, day/night, end-to-end sensor-to-shooter precision strike capability and to demonstrate and experiment with potential solutions to these barriers. The FY96/97 demonstration was conducted in Korea and successfully demonstrated an enhanced capability to defeat the 240mm MRL threat and provided the Commander-in-Chief, United States Forces Korea (CINC USFK), tactical “leave behind” enhanced capabilities. Leave behind products will continue to be fielded and supported in FY97/98. This program element also funds development activities for a high resolution Synthetic Aperture Radar Target Recognition and Location System (STARLOS) with real time Aided Target Recognition (ATR). The work in this program element is closely coordinated with the Joint Staff, other services, the Army’s combat development community, TRADOC Battle Labs, and appropriate materiel developers to conduct field demonstrations and experiments to assess specific technologies for military needs 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, Project Reliance, and the Joint Warfare Science and Technology Plan. The work also supports Force XXI and the Army Warfighting Experiments (AWEs).

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603238A Air Defense/Precision Strike Technology</b> |                     |                     |                           |                              | PROJECT<br><b>D177</b> |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| D177 JT ALS PS Demo   | 33624             | 13997               | 6066                | 1473   | 18798               | 18029               | 17971                     | 15819                        | Continuing             | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> The Joint Air Land Sea Precision Strike Demonstration 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 FY95 the Precision/Rapid Counter-Multiple Rocket Launcher (P/RC-MRL) Advanced Concept Technology Demonstration (ACTD) program was initiated and a Continental United States (CONUS) ACTD demonstration was successfully conducted as a first step towards accomplishing the objective Outside CONUS (OCONUS) ACTD demonstration in FY96/97. The successful FY95/96 demonstration underscored the validity of the JPSD approach in countering the MRL threat and more accurately depicted the value added by each of the leave-behind systems. The OCONUS demonstration was conducted in Korea in September and October 1996. It successfully exhibited an enhanced capability to find, track and defeat the 240mm MRL threat. Delivery and support of leave behind capabilities began in FY96 and will continue during FY 97/98. Leave behind capabilities include: connectivity between the Korean Combat Operations Information Center and the 2nd Infantry Division; enhancements to the Firefinder radar system; automation for the 2nd Infantry Division Main Command Post; Automated Weapon Target Pairing software for artillery battalions; enhancements of Army connectivity to Air Force and Navy command and control; and Aided Target Recognition capability for the Tactical Endurance Synthetic Radar (TESAR) sensor that flies on Predator. Additionally, two years of in-country follow-on support will provide a residual operational capability to immediately improve the ability of CINC U. S. Forces Korea/Combined Forces Command (USFK/CFC) to defeat the 240mm MRL threat. Later work efforts include application of P/RC-MRL ACTD products and lessons learned to a joint follow-on effort as well as assessing applications to other Army/Joint Precision strike requirements. Initial planning for the Survivable Armed Reconnaissance on the Digital Battlefield (SARDB) ACTD took place in FY96. Following Congressional disapproval of funds for SARDB for FY 97, funding for this program in FY 98/99 was reprogrammed to other DoD requirements. Efforts in this PE are managed by the Director, Joint Precision Strike Demonstration, Program Executive Officer, Intelligence and Electronic Warfare (PEO-IEW), Ft. Belvoir, VA. The prime contractor is Raytheon, Bedford, MA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 10190 - Enhanced surveillance, target acquisition, strike planning and Army and joint weapons delivery assets.             <ul style="list-style-type: none"> <li>- Formulated the SARDB ACTD program and conducted pre-ACTD activities.</li> <li>- Prepared and staffed a draft SARDB ACTD Implementation Directive and Management Plan.</li> </ul> </li> <li>• 17915 - Developed, fabricated and evaluated 2nd Generation Forward Looking Infrared Radar/Line Scan (FLIR/LS) and integrated into a surrogate Unmanned Aerial Vehicle (UAV) airframe.             <ul style="list-style-type: none"> <li>- Developed and implemented software changes for the Firefinder system to significantly enhance its capabilities.</li> <li>- Planned, trained for and initiated execution of the OCONUS portion of the Precision/Rapid Counter MRL ACTD with USFK, 2nd ID (M), TRADOC Battle Labs and the Air Force and Navy.</li> </ul> </li> </ul> |                   |                     |                     |  |                     |                     |                           |                              |                        |            |
| Project D177  |                   |                     | Page 2 of 6 Pages   |  |                     |                     | Exhibit R-2 (PE 0603238A) |                              |                        |            |

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| BUDGET ACTIVITY   | PE NUMBER AND TITLE                                     | PROJECT                      |
| <b>3 - Advanced Technology Development</b>  | <b>0603238A Air Defense/Precision Strike Technology</b> | <b>D177</b>                  |
| <p align="center">- Participated in DARPA, Medium/High Altitude Endurance and Synthetic Theater of War programs.</p> <p><b>FY 1996 Accomplishments: (continued)</b></p> <ul style="list-style-type: none"> <li>• 4836 - Developed the multimode communications connectivities and architecture of the Integration and Evaluation Center (IEC) to support the OCONUS demo and Army AWEs. Integrated models/simulations needed for OCONUS demo.</li> <li>- Completed the FY 95/96 P/RC-MRL CONUS demonstration, gathered data and conducted detailed analysis.</li> <li>• 683 - Conducted initial planning for the Rapid Terrain Visualization (RTV), formerly the Rapid Battlefield Visualization, ACTD, which is separately funded in PE 0603734A (Military Engineering Advanced Technology)/Project DT12 beginning in FY97.</li> </ul> <p>Total 33624</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 8000 - Complete the P/RC-MRL ACTD OCONUS demonstration.</li> <li>- Acquire enhanced surveillance, target acquisition, strike planning and Army and Joint command and control assets.</li> <li>- Evaluate potential use of 2nd Gen FLIR/LS on the Predator UAV and other tactical platforms.</li> <li>- Assess potential application of P/RC-MRL ACTD products to other USFK Precision Strike requirements.</li> <li>• 5658 - Prepare and distribute a comprehensive report on the FY96/97 ACTD OCONUS demonstration.</li> <li>- Expand and upgrade technical capabilities of the IEC to support rapid acquisition process, operational planning for real world contingency operations and participation in Army/Joint war game activities and other technical assessments.</li> <li>- Develop and implement transition plan for the P/RC-MRL ACTD leave behind systems. Provide logistics, maintenance and training support for P/RC-MRL leave behind systems.</li> <li>• 339 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 13997</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6066 - Complete the transition of P/RC-MRL ACTD leave behinds to CINC USFK.</li> <li>- Continue leave behind systems support for the P/RC-MRL ACTD.</li> <li>- Develop and publish a comprehensive P/RC-MRL ACTD report.</li> <li>- Continue assessment of P/RC-MRL products to other Army/Joint Precision Strike requirements.</li> <li>- Continue technical growth, as required, of IEC capabilities.</li> </ul> <p>Total 6066</p> |   |                              |
| Project D177  | Page 3 of 6 Pages                                       | Exhibit R-2 (PE 0603238A)    |

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|--|---|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|--|--|--|--|--------------------------|-------|-------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603238A Air Defense/Precision Strike<br/>Technology</b> | <b>PROJECT</b><br><b>D177</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1473 - Initiate detailed planning and approval process for a Joint follow-on effort to P/RC-MRL, supporting CINC USFK/CFC.</li> </ul> <p>Total 1473</p>  |   |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">33624</td> <td style="text-align: center;">32046</td> <td style="text-align: center;">23198</td> <td style="text-align: center;">22659</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">33624</td> <td style="text-align: center;">13997</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">33624</td> <td style="text-align: center;">13997</td> <td style="text-align: center;">6066</td> <td style="text-align: center;">1473</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY97 reduction (-17600) by Congress for SARDB program.<br/>FY98/99 reductions (-17000 and -21000, respectively) deleted remaining SARDB funding.</p> |   |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 33624 | 32046 | 23198 | 22659 | Appropriated Value | 33624 | 13997 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 33624 | 13997 | 6066 | 1473 |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |
| FY 1997 President's Budget   | 33624   | 32046                         | 23198          | 22659          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |
| Appropriated Value   | 33624   | 13997                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |
| Adjustments to Appropriated Value  |   |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |
| FY 1998 Pres Bud Request   | 33624   | 13997                         | 6066           | 1473           |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |
| Project D177   | Page 4 of 6 Pages   | Exhibit R-2 (PE 0603238A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |  |  |  |  |                          |       |       |      |      |

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|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|-------------------------------|---------------------|------------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603238A Air Defense/Precision Strike Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D546</b> |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D546 STARLOS   | 4006              | 8012                | 5598                | 3453  | 0                   | 0                   | 0                         | 0                             | 0                   | 21069      |
| <p><b>A. Mission Description and Justification:</b> A technology program to demonstrate the feasibility of locating and identifying high value targets from an Army designated aerial platform. The focus of the program is on Aided Target Recognition (ATR) of short range ballistic missiles, surface-to-air missile launchers, rocket launchers and aided target cueing (ATC) of military targets of interest. The targets are located and identified by means of a high resolution synthetic aperture radar (SAR) with a real-time ATR system. The program has become a major component of the Joint Precision Strike Demonstration (JPSPD) 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). The program delivers an interim ATR solution in FY97 and a final ATR solution in FY98 for installation into the Predator UAV ground control station (GCS) as an enhancement to the JPSPD Precision/Rapid Counter-MRL ACTD. This program is managed by Program Executive Officer-Intelligence and Electronic Warfare, PM Tactical Endurance Synthetic Aperture Radar, with matrix support from Army Research Laboratory, Adelphi, MD and Night Vision and Electronic Sensors Directorate, CECOM RDEC, Fort Monmouth, NJ.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2855 - Evaluated industry/government SAR ATR/ATC algorithms for planned FY97 procurement of commercial-off-the-shelf (COTS) hardware and algorithms of SAR ATR/ATC. <ul style="list-style-type: none"> <li>- Initiated procurement of a completely COTS SAR ATR/ATC processor.</li> <li>- Developed ATR/ATC capability for target cueing, rapid target insertion efforts, and definition of SAR ATR/ATC requirement with the user through the use of user mini-experiments.</li> <li>- Completed integration of a multi-sensor testbed (MSTB) for on board demonstration of real time SAR ATR/ATC.</li> </ul> </li> <li>• 1151 - Participated in JTF-1 exercise with 525th MI Bde and Enhanced Tactical Radar Correlator (ETRAC) with the PM TESAR-developed SAR and the Army Mobile Test Facility (MTF). <ul style="list-style-type: none"> <li>- Participated in JPSPD Sensor/ATR demo at Fort A.P. Hill.</li> <li>- Procured and integrated MAE UAV SAR in support of JPSPD P/RC-MRL ACTD.</li> </ul> </li> </ul> <p>Total 4006</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4830 - Integrate and install aided target recognition (ATR) algorithms and hardware upgrades into the Predator Ground Station for the JPSPD P/RC MRL ACTD interim leave behind. <ul style="list-style-type: none"> <li>- Participate in MAE/UAV STARLOS integration demonstration for P/RC MRL ACTD and other demonstrations and experiments with the multi-sensor testbed (MSTB).</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                     |                           |                               |                     |            |
| Project D546   |                   |                     | Page 5 of 6 Pages   |   |                     |                     | Exhibit R-2 (PE 0603238A) |                               |                     |            |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>                                   | <b>PE NUMBER AND TITLE</b><br><b>0603238A Air Defense/Precision Strike<br/>Technology</b>  | <b>PROJECT</b><br><b>D546</b> |                |                |
| <b>FY 1997 Planned Program: (continued)</b>  |  |                               |                |                |
|  | - Incorporate selected DARPA research and development technology to include interactive ATR, image registration, and object level change detection in support of the Bosnia mission with the Predator UAV. |                               |                |                |
| • 2990   | - Conduct data collect for the Korean targets of interest using the MSTB.  |                               |                |                |
|  | - Demonstrate real-time ATR capability of SAR using COTS hardware and demonstrate cross cueing of SAR and MTI in the MSTB.   |                               |                |                |
| 192  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                               |                |                |
| Total  | 8012   |                               |                |                |
| <b>FY 1998 Planned Program:</b>  |  |                               |                |                |
| • 1198   | - Complete and test ATR algorithm upgrade for 240mm MRL target.  |                               |                |                |
|  | - Incorporate ATR algorithm and false alarm mitigation techniques in UAV Ground Control Station (GCS).   |                               |                |                |
| • 2200   | - Integrate UAV GCS hardware upgrade for ATR with existing GCS system.   |                               |                |                |
|  | - Test and demonstrate the P/RC-MRL ACTD final leave-behind.   |                               |                |                |
| • 1600   | - Perform data collection using MSTB for expanded target set for Korean and Bosnia scenarios.  |                               |                |                |
| • 600  | - Refine enhanced SAR ATR algorithms and demonstrate capabilities.   |                               |                |                |
| Total  | 5598   |                               |                |                |
| <b>FY 1999 Planned Program:</b>  |  |                               |                |                |
| • 1000   | - Demonstrate end-to-end advanced SAR/ATR capability via multi-sensor testbed.   |                               |                |                |
| • 2000   | - Incorporate enhanced SAR ATR algorithms and expanded target set into processor hardware.   |                               |                |                |
| • 453  | - Finalize technical/logistic support for P/RC-MRL ACTD.   |                               |                |                |
| Total  | 3453   |                               |                |                |
| <b>B. Project Change Summary</b>   |  |                               |                |                |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 4106   | 8212                          | 5867           | 3853           |
| Appropriated Value   | 4220   | 8012                          |                |                |
| Adjustments to Appropriated Value  | -214   |                               |                |                |
| FY 1998 President's Budget   | 4006   | 8012                          | 5598           | 3453           |
| Change Summary Explanation: Funding: FY99 - Funds reprogrammed (-400) to higher priority requirements. |  |                               |                |                |
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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603270A Electronic Warfare (EW) Technology</b> |
|--|--|

| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|---|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| Total Program Element (PE) Cost   | 3818              | 6651                | 8182                | 11754               | 18064               | 17831               | 15729               | 17486               | Continuing          | Continuing |
| DK15 Advanced Communications Electronics Countermeasures Demonstration      | 2809              | 2852                | 2883                | 3121                | 8526                | 7435                | 8228                | 9254                | Continuing          | Continuing |
| DK16 Non-Communications Electronic Countermeasures Technology Demonstration | 1009              | 3799                | 5299                | 8633                | 9538                | 10396               | 7501                | 8232                | Continuing          | Continuing |

**Mission Description and Budget Item Justification:** This program element funds two projects that provide technology options for current and future electronic warfare (EW) systems. The Advanced Communications Electronics Countermeasures Demonstration (DK15) provides technology demonstrations in communications countermeasures (CM) 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 multispectral countermeasures advanced technology demonstration, and provides component technology for the hit avoidance technology demonstration. Work in this program element adheres to tri-service Reliance agreements on electronic warfare. Work in this program element is related to and fully coordinated with efforts in PE 0602270A (Electronic Warfare Technology), and various Navy and Air Force program elements in accordance with the on-going Reliance joint planning process. Navy developments are conducted in PEs 0604755N (Ship Self Defense), 0204575N (Electronic Warfare Support), and 0604573N (Shipboard Electronic Warfare Improvements). Air Force developments are conducted in PEs 0604738F (Protective Systems), 0604793F (Tactical Protective Systems) and 0604710F (Reconnaissance Electronics Warfare Systems). Coordination is effected between the Services and Defense Advanced Research Projects Agency (DARPA) to eliminate duplication of effort and ensure the interchange of technical data. This program is managed primarily by Communications-Electronics Command Research, Development and Engineering Center (CERDEC), Ft. Monmouth, NJ. 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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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------------|---------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603270A Electronic Warfare (EW) Technology</b> |                     |                           |                     | PROJECT<br><b>DK15</b>       |                     |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| DK15 Advanced Communications Electronics Countermeasures Demonstration  | 2809              | 2852                | 2883                | 3121  | 8526                | 7435                      | 8228                | 9254                         | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2259 -Completed demonstration and testing of exploitation strategies for type 1 mobile cellular radio signals. Provided technology options for IEWCS. -Completed demonstration and testing of signal processing, control equipment and software techniques to demonstrate capability to identify and jam digital radio signals. -Initiated integration of exploitation strategies for type 2 mobile cellular radio signals for demonstration purposes. -Completed demonstrations of signals intelligence (SIGINT) asset management and automated map based intelligence sensor system (AMBISS). Transitioned to intelligence electronic warfare common sensor (IEWCS) and all source analysis system (ASAS).</li> <li>• 550 -Initiated IEW demonstration of asset management, terrain management, and overlay reasoning technologies developed in PE 0602270A/A906. -Integrated SIGINT/moving target indicator (MTI) templating, tracking, cross-cueing and situation display techniques. -Demonstrated 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. Demonstrated capability at train up for Task Force XXI advanced warfighting experiment (AWE).</li> </ul> <p>Total 2809</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1532 -Demonstrate utilization of techniques to exploit several complex communications formats. -Integrate wide band receiver and developments from joint receiver programs for demonstration of receivers used in the exploitation of modern communications signals. -Complete IEW asset management, terrain management and overlay reasoning demonstration and provide technology options for ASAS. Demonstrate at Task Force XXI AWE.</li> <li>• 1250 -Conduct field evaluation of SIGINT/MTI templating, tacking, cross-cueing and situation display techniques.</li> </ul> |                   |                     |                     |   |                     |                           |                     |                              |                     |            |
| Project DK15  |                   |                     | Page 2 of 5 Pages   |   |                     | Exhibit R-2 (PE 0603270A) |                     |                              |                     |            |

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|--|--|---|----------------|----------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE  | PROJECT   |                |                |
| <b>3 - Advanced Technology Development</b>                     | <b>0603270A Electronic Warfare (EW) Technology</b>   | <b>DK15</b>   |                |                |
| <b>FY 1997 Planned Program: (continued)</b>                    |  |   |                |                |
|  | -Field test battle damage assessment prototype with 18th Airborne Corps  |   |                |                |
|  | -Continue consolidation and testing of IEW airborne asset management tools prior to demonstration.   |   |                |                |
|  | -Continue demonstration of 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 to support Task Force XXI AWE. |   |                |                |
| •  | 70   | -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                |                |
| Total  | 2852   |   |                |                |
| <b>FY 1998 Planned Program:</b>                                |  |   |                |                |
| •  | 1400   | -Perform field evaluation/demonstration of attack techniques against modern communication signals.  |                |                |
|  |  | -Perform laboratory and field evaluation of high frequency (HF) and very high frequency (VHF) jamming antenna technology.   |                |                |
| •  | 888  | -Demonstrate operational effectiveness of a wide bandwidth SIGINT electronic support package on a short-range UAV platform operating in conjunction with a ground base IEWCS. |                |                |
| •  | 595  | -Complete prototype using smart agents to support effective tasking and reporting of multi-intelligence sensor data integrated into ASAS Block II and IEWCS.                  |                |                |
|  |  | -Develop initial prototype of terrain reasoning and SIGINT templating capability.   |                |                |
|  |  | -Continue to upgrade airborne asset management prototype.   |                |                |
|  |  | -Transition full military intelligence (MI) sensor asset management tools and techniques into ASAS and IEWCS.   |                |                |
| Total  | 2883   |   |                |                |
| <b>FY 1999 Planned Program:</b>                                |  |   |                |                |
| •  | 2380   | -Initiate demonstration against modern communication signals using the field programmable gate array analysis/control system.   |                |                |
|  |  | -Perform laboratory and field evaluation of capabilities against more complex modern communication signals.   |                |                |
|  |  | -Continue antenna technology prototyping to support modern communication exploitation evaluations.  |                |                |
| •  | 741  | -Complete airborne asset management prototype. Product transitions to IEWCS and ASAS.   |                |                |
|  |  | -Complete advanced terrain reasoning prototype. IEWCS and ASAS will be upgraded with this capability.   |                |                |
|  |  | -Complete SIGINT templating prototype. IEWCS and ASAS will be upgraded with this capability.  |                |                |
| Total  | 3121   |   |                |                |
| <b>B. Project Change Summary</b>                               |  |   |                |                |
|  | <u>FY 1996</u>   | <u>FY 1997</u>  | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget                                     | 2881   | 2913  | 2878           | 3117           |
| Appropriated Value   | 2963   | 2852  |                |                |
| Adjustments to Appropriated Value                              | -154   |   |                |                |
| Project DK15   |  |   |                |                |

DATE  
**February 1997**

BUDGET ACTIVITY  
**3 - Advanced Technology Development**

PE NUMBER AND TITLE  
**0603270A Electronic Warfare (EW) Technology**

FY 1998 Pres Bud Request

2809      2852      2883      3121

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603270A Electronic Warfare (EW) Technology</b> | <b>PROJECT</b><br><b>DK16</b> |
|--|--|-------------------------------|

| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|--|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| DK16 Non-Communications Electronic Countermeasures<br>Technology Demonstration | 1009              | 3799                | 5299                | 8633                | 9538                | 10396               | 7501                | 8232                | Continuing          | Continuing |

**A. Mission Description and Justification:** 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 (IR) threats. The multispectral countermeasures advanced technology demonstration (MSCM ATD) provides technology options for product improvements to the suite of integrated infrared countermeasures/common missile warning system (SIIRCM/CMWS), which provides the primary protection to Army helicopters against infrared seeker missiles. Specifically, advancements in laser technology will provide a multi line laser for improved self protection, advancements in fiber optic technology for improved transmission to the SIIRCM jamhead, and the evaluation of infrared (IR) countermeasure (CM) techniques versus IR imaging missiles.

**FY 1996 Accomplishments:**

- 1009 -Developed algorithms for passive missile warning, integrated ground vehicle top attack missile warning components, and delivered top attack warning subsystem to hit avoidance advanced technology demonstration (ATD).
- Total 1009

**FY 1997 Planned Program:**

- 3712 -Evaluate candidate fiber optic cables and jamming waveforms to increase jam to signal ratios; evaluate Air Force Lincoln Labs diode pumped, long pulse laser technology as an alternative to defense advanced projects agency (DARPA) solid state multiline, short pulse lasers; initiate development of interfaces between laser modules and multispectral countermeasures test bed hardware.
  - 87 -Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 3799

**FY 1998 Planned Program:**

- 3500 -Complete integration of laser modules with multispectral countermeasures test bed, and begin integration of band four fiber optic cable.
  - 1799 -Collect missile signature data to support improved detection algorithm developments; initiate development of warning and countermeasures against far IR laser beam rider threats.
- Total 5299

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> | PE NUMBER AND TITLE<br><b>0603270A Electronic Warfare (EW) Technology</b> | PROJECT<br><b>DK16</b> |
|---|---|------------------------|

- FY 1999 Planned Program:**
- 7000 – Complete multispectral countermeasures test bed; conduct system integration lab tests and live fire cable car tests against advanced pseudo imaging and imaging surface to air missiles; demonstrate detection and countermeasures against guided missiles that can engage both rotary wing aircraft and ground vehicles.  
– Transition alternative laser technologies, jamming waveforms, fiber optic cable and missile detection algorithms as technology options for SIIRCM product improvement.
  - 1633 -Continue development of laser beam rider detection and jamming demonstrator using SIIRCM as core demonstration system.
- Total 8633

|   |                |                |                |                |
|---|----------------|----------------|----------------|----------------|
| <b><u>B. Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget              | 1031           | 3881           | 5303           | 8651           |
| Appropriated Value                      | 1059           | 3799           |                |                |
| Adjustments to Appropriated Value       | -50            |                |                |                |
| FY 1998 Pres Bud Request                | 1009           | 3799           | 5299           | 8633           |

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|--|----------------|------------------|------------------|---|------------------|------------------|------------------|------------------|-----------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                |                  |                  | PE NUMBER AND TITLE<br><b>0603313A Missile and Rocket Advanced Technology</b> |                  |                  |                  |                  |                       |            |
| COST (In Thousands)  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete      | Total Cost |
| Total Program Element (PE) Cost  | 109972         | 99819            | 117139           | 89542   | 49582            | 23675            | 16147            | 21243            | Continuing            | Continuing |
| D206 Missile Simulation  | 2497           | 1                | 3013             | 3434  | 3675             | 3660             | 3684             | 3990             | Continuing            | Continuing |
| D263 Future Missile Technology Integration (FMTI)  | 19174          | 9541             | 1043             | 19  | 1001             | 963              | 12463            | 17253            | Continuing            | Continuing |
| D375 Low Cost Autonomous Attack Submunition (LOCAAS)   | 2372           | 0                | 0                | 0   | 0                | 0                | 0                | 0                | 0                     | 2372       |
| D380 Multi-Platform Launcher   | 3582           | 13232            | 12431            | 8780  | 5489             | 0                | 0                | 0                | 0                     | 43514      |
| D387 Multi-Purpose Individual Munition   | 4907           | 625              | 0                | 0   | 0                | 0                | 0                | 0                | 0                     | 5532       |
| D486 Rapid Force Projection Simulation   | 5627           | 7656             | 8390             | 5111  | 0                | 0                | 0                | 0                | 0                     | 26784      |
| D493 Rapid Force Projection Demonstration  | 16537          | 23737            | 29682            | 27772   | 13513            | 11317            | 0                | 0                | 0                     | 112558     |
| D496 Enhanced Fiber Optic Guided Missile (EFOG-M)  | 55276          | 36214            | 57734            | 36605   | 14948            | 3791             | 0                | 0                | 0                     | 204568     |
| D549 2.75 Inch Anti-Air TD   | 0              | 0                | 2905             | 2896  | 0                | 0                | 0                | 0                | 0                     | 5801       |
| D550 Counter Active Protection System  | 0              | 1                | 1941             | 4408  | 5467             | 0                | 0                | 0                | 0                     | 11817      |
| D567 LCPK for 2.75 Inch Rockets  | 0              | 0                | 0                | 517   | 5489             | 3944             | 0                | 0                | 0                     | 9950       |
| D703 Hydra-70 Rocket PIP   | 0              | 8812             | 0                | 0   | 0                | 0                | 0                | 0                | 0                     | 8812       |
| <p><b>Mission Description and Budget Item Justification:</b> This program element provides 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.</p> |                |                  |                  |   |                  |                  |                  |                  |                       |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   | PE NUMBER AND TITLE<br><b>0603313A Missile and Rocket Advanced Technology</b> |                              |
| <p>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 hypervelocity missile technologies. This program element also provides full integration of battlefield technologies including hunters (forward sensors) and killers (weapons) integrated through advanced command and control. These components will demonstrate a system of systems approach through the umbrella of the Rapid Force Projection Initiative (RFPI) Early Entry Demonstration, which will provide enhanced survivability and lethality for light, early-entry U.S. forces in a contingency role. The RFPI demonstration supports four of the twelve 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 DoD 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, Project Reliance, and supports multiple Defense Technology Objectives. This program element supports the U.S. Army Training and Doctrine Command (TRADOC) Battle Labs. Work in this program element is related to and fully coordinated with efforts in PE 0601104A (University and Industry Research Centers), PE 0602303A (Missile Technology), PE 0603238A (Air Defense/Precision Strike Technology), and PE 0603363F in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments. 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.</p> |   |                              |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                           |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                           | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D206</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate       | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D206 Missile Simulation  | 2497              | 1                   | 3013                      | 3434   | 3675                | 3660                | 3684                      | 3990                         | Continuing                    | Continuing |
| <p><b>A. Mission Description and Justification:</b> 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 Defense Advanced Research Projects Agency (DARPA) 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1853 - Upgraded and improved RF HWIL simulation capabilities with new hardware (instrumentation and computers) to support LONGBOW, pre-planned product improvement (P3I) BAT, and PATRIOT Advanced Capability Block 3(PAC-3) development.             <ul style="list-style-type: none"> <li>- Developed new HWIL simulation capabilities to support customers in other services and friendly foreign governments with electronic countermeasure evaluations.</li> <li>- Implemented infrared target scene projector for application to JAVELIN, BAT, Future Missile Technology Integration (FMTI) (formerly The Army Combined Arms Weapon System ), and Theater High Altitude Air Defense (THAAD )development via hardware-in-the-loop simulation.</li> <li>- Reconfigured the Electro-Optical Simulation System for HWIL simulation of EFOG-M and FMTI (TACAWS) by addition of a rotational flight motion simulator, computers and infrared instrumentation..</li> </ul> </li> <li>• 644 - Expanded 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/BAT) and Multiple Launch Rocket System (MLRS).             <ul style="list-style-type: none"> <li>- Developed improvements to the BEWSS suite of simulation models.</li> </ul> </li> </ul> <p>Total 2497</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1 - Plan FY98 program.</li> </ul> <p>Total 1</p> |                   |                     |                           |  |                     |                     |                           |                              |                               |            |
| Project D206   |                   |                     | <i>Page 3 of 28 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0603313A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D206</b> |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1950 - Complete the development of computer-controlled precision signal measurement instrumentation for microwave and millimeter wave radar hardware-in-the-loop simulation capabilities. <ul style="list-style-type: none"> <li>- Initiate development of technology which supports hardware-in-the-loop simulation of dual-spectrum (infrared and millimeter wave radar) guided and sensor-fuzed tactical missiles and submunitions (BAT P3I and SADARM PI).</li> <li>- Extend infrared target and background scene projector technology by increasing pixel dimensions and frame rates and by improving non-uniformity correction algorithms.</li> </ul> </li> <li>Investigate infrared scene projector "leap ahead" technology in an effort to overcome limitations of present scene projector technologies. <ul style="list-style-type: none"> <li>- Continue development of hardware/software based on commercial off-the-shelf products for real-time target scene generation for driving electro-optical scene projectors.</li> </ul> </li> <li>• 1063 - Complete the reconfiguration of the Electro-Optical Simulation System to provide hardware-in-the-loop simulation support to EFOG-M, FMTI, and THAAD missile systems. <ul style="list-style-type: none"> <li>- Upgrade MICOM DIS Center real-time data processing and display support essential virtual prototype simulator development and exercise operations.</li> <li>- Upgrade BEWSS test bed capabilities to support DIS exercises integrating live, virtual, and constructive forces into a seamless environment.</li> </ul> </li> </ul> <p>Total 3013</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2584 - Continue the development of a hardware-in-the-loop (HWIL) simulation capability for dual-spectrum (passive infrared and millimeter wave radar) guided and sensor-fuzed tactical missiles and sub-munitions to support development of BAT P3I, SADARM PI, their successors, and other dual mode guided weapons. <ul style="list-style-type: none"> <li>- Upgrade infrared scene projection capability by improving the laser diode projector performance and fabricating electronics for a resistive element chip of at least 512x512 pixel dimensions. Upgrade scene generator performance with additional processors and improved software to provide acquisition support to EFOG-M, Follow-on To TOW (FOTT), THAAD, and other infrared guided weapons.</li> <li>- Continue development of "leap ahead" infrared scene projector technology to overcome disadvantages of all present projector systems. This technology will support development and test and evaluation for all infrared guided missiles and submunitions.</li> <li>- Develop integrated microcircuits for intermediate/radio frequency (RF) phase coherency, delay, and quadrature modulator functions with improved bandwidth and noise characteristics to insert benefits of digital electronics into radar signal generation for HWIL simulation. This effort will support LONGBOW, PAC-3, and other millimeter wave radar guided missiles.</li> <li>- Improve performance of computer-controlled special-purpose precision signal measurement instrumentation for microwave and millimeter wave radar HWIL simulation capabilities.</li> </ul> </li> </ul> |  |                               |
| Project D206   | Page 4 of 28 Pages   | Exhibit R-2 (PE 0603313A)     |

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|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|---|--|--|-----------------------------------|------|--|--|--|------------------------------------|------|---|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D206</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 850 - Provide upgraded virtual prototype and real-time computer generated forces capability for the Distributed Interactive Simulation Center, including improved accuracy and lower cost to meet R&amp;D needs.</li> <li>- Implement upgraded BEWSS test bed capability to provide improved control, integration, operation, data collection and analysis.</li> <li>- Upgrade BEWSS environmental models to support engineering evaluation of enhanced weapon system seekers/sensors.</li> </ul> <p>Total 3434</p>   |  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">3064</td> <td style="text-align: center;">2973</td> <td style="text-align: center;">3007</td> <td style="text-align: center;">3928</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3150</td> <td style="text-align: center;">1</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-653</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 President's Budget Request</td> <td style="text-align: center;">2497</td> <td style="text-align: center;">1</td> <td style="text-align: center;">3013</td> <td style="text-align: center;">3434</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996- Funding reprogrammed to higher priority requirements.<br/> FY 1997- Funding (-2972) redirected to Congressionally-mandated Hydra-70 product improvement program.<br/> FY 1998- Funding reprogrammed (-494) to higher priority requirements.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 3064 | 2973 | 3007 | 3928 | Appropriated Value | 3150 | 1 |  |  | Adjustments to Appropriated Value | -653 |  |  |  | FY 1998 President's Budget Request | 2497 | 1 | 3013 | 3434 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |
| FY 1997 President's Budget  | 3064   | 2973                          | 3007           | 3928           |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |
| Appropriated Value  | 3150   | 1                             |                |                |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |
| Adjustments to Appropriated Value   | -653   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |
| FY 1998 President's Budget Request  | 2497   | 1                             | 3013           | 3434           |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |
| Project D206  | Page 5 of 28 Pages   | Exhibit R-2 (PE 0603313A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |   |  |  |                                   |      |  |  |  |                                    |      |   |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D263</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D263 Future Missile Technology Integration (FMTI)   | 19174             | 9541                | 1043                | 19   | 1001                | 963                 | 12463                     | 17253                        | Continuing                    | Continuing |
| <p><b>A. <u>Mission Description Justification:</u></b> 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, training, etc. 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 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 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<sup>2</sup>S) technology transitioned from the Balanced Technology Initiative program will continue to 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-tracked wire-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. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command (MICOM), Redstone Arsenal, AL. Major contractors are Raytheon Company, Electronic Systems, Tewksbury, MA; TRW Space Electronics Group, Redondo Beach, CA; Loral Communications Systems, Salt Lake City, UT.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 12893 - Completed procurement of flight hardware.<br/>- Completed seeker captive flight tests.</li> <li>• 6281 - Initiated construction of HWIL simulation of flight hardware.<br/>- Completed six degrees of freedom (6DOF) simulation system evaluation and supported missile flight tests.</li> </ul> <p>Total 19174</p> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project D263  |                   |                     | Page 6 of 28 Pages  |  |                     |                     | Exhibit R-2 (PE 0603313A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>                                      | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b>          | <b>PROJECT</b><br><b>D263</b> |                |                |
| <b>FY 1997 Planned Program:</b>   |   |                               |                |                |
| • 9342  | - Design and fabricate gunner fire control console.   |                               |                |                |
|   | - Initiate technology demonstration flight tests.   |                               |                |                |
|   | - Transition technology to ongoing missile programs (e.g. Follow-On-To-TOW and EFOG-M).       |                               |                |                |
| 199   | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs. |                               |                |                |
| Total   | 9541  |                               |                |                |
| <b>FY 1998 Planned Program:</b>   |   |                               |                |                |
| • 1043  | - Complete technology demonstration flight tests.   |                               |                |                |
|   | - Transition final documentation to technology transition database.                           |                               |                |                |
|   | - Complete final report.  |                               |                |                |
| Total   | 1043  |                               |                |                |
| <b>FY 1999 Planned Program:</b>   |   |                               |                |                |
| • 19  | - Develop program plan for proposed ATD.  |                               |                |                |
| Total   | 19  |                               |                |                |
| <b>B. Project Change Summary</b>  |   |                               |                |                |
|   | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget  | 18615   | 9020                          | 1029           | 1297           |
| Appropriated Value  | 19137   | 9541                          |                |                |
| Adjustments to Appropriated Value   | 37  |                               |                |                |
| FY 1998 Pres Bud Request  | 19174   | 9541                          | 1043           | 19             |
| Change Summary Explanation: Funding: FY 1999- Funds (-1278) reprogrammed to higher priority requirements. |   |                               |                |                |
|   |   |                               |                |                |
| Project D263  | Page 7 of 28 Pages  | Exhibit R-2 (PE 0603313A)     |                |                |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D375</b> |
|--|--|-------------------------------|

| COST (In Thousands)                                  | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|--|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| D375 Low Cost Autonomous Attack Submunition (LOCAAS) | 2372           | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 0                | 2372       |

**A. Mission Description and Justification:** Additional funds were provided by Congress in this program element for the LOCAAS project. This project provided for the demonstration of the tactical Laser Radar (LADAR) seeker intended for use in powered submunitions. The project demonstrated the technology in weather and countermeasures. A weather and countermeasures performance data base for the LADAR seeker was built for use in the MLRS Smart Tactical Rocket (MSTAR) cost, operations, and effectiveness analysis (1996-1997) and other battlefield simulations. Work was performed by the Research, development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. The major contractor was Loral Vaught Systems of Dallas, Texas.

**FY 1996 Accomplishments:**

- 2372 - Began configuration of LADAR seeker for captive flight testing.
  - Completed captive flight test planning.
- Total 2372

**FY 1997 Planned Program:** Project not funded in FY 97.

**FY 1998 Planned Program:** Project not funded in FY 98.

**FY 1999 Planned Program:** Project not funded in FY 99.

**B. Project Change Summary**

|                                    | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> |
|------------------------------------|----------------|----------------|----------------|----------------|
| FY 1997 President's Budget         | 2433           | 0              |                | 0              |
| Appropriated Value                 | 2500           |                |                |                |
| Adjustments to Appropriated Value  | 128            |                |                |                |
| FY 1998 President's Budget Request | 2372           | 0              | 0              | 0              |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>D380</b> |                     |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate    | Cost to<br>Complete | Total Cost |
| D380 Multi-Platform Launcher  | 3582              | 13232               | 12431               | 8780  | 5489                | 0                   | 0                         | 0                      | 0                   | 43514      |
| <p><b>A. Mission Description and Justification:</b> This project is part of the Rapid Force Projection Initiative (RFPI) ACTD for early entry forces and is also tied to the Joint Precision Strike Demonstration (JPSD) Precision/Rapid Counter Multiple Rocket Launcher (MRL) ACTD. The Multi-Platform Launcher (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 (to FY 1998) 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 1746 - Constructed flight computers, algorithms and software. <ul style="list-style-type: none"> <li>- Constructed control actuation systems.</li> <li>- Completed design of global positioning system (GPS) algorithms.</li> <li>- Established GPS antenna and receiver specifications.</li> </ul> </li> <li>• 1836 - Developed electronic and power systems. <ul style="list-style-type: none"> <li>- Developed launcher interfaces.</li> <li>- Performed structural/thermal and aerodynamic analysis.</li> <li>- Developed inertial measurement units.</li> </ul> </li> </ul> <p>Total 3582</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5105 - Perform software integration and testing. <ul style="list-style-type: none"> <li>- Perform system integration and hardware-in-the-loop testing.</li> <li>- Perform navigation/autopilot/guidance analysis.</li> <li>- Develop telemetry system.</li> <li>- Develop and test roll-control bearing.</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                     |                           |                        |                     |            |
| Project D380  |                   |                     | Page 9 of 28 Pages  |   |                     |                     | Exhibit R-2 (PE 0603313A) |                        |                     |            |

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|--|--|------------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE  | PROJECT                      |
| <b>3 - Advanced Technology Development</b>                     | <b>0603313A Missile and Rocket Advanced Technology</b>   | <b>D380</b>                  |
| <b>FY 1997 Planned Program: (continued)</b>                    |  |                              |
|  | - Develop and test missile electronic unit.  |                              |
| • 1756   | - Develop and test GPS components (receiver and antenna).  |                              |
|  | - Develop GPS guidance algorithms, receiver, and antenna.  |                              |
| • 2926   | - Conduct risk reduction pre-EMD design on safe and arm, electronics miniaturization, warhead packaging, and launcher operations.                              |                              |
| • 3122   | - Initiate safety qualification and man rating evaluations of HIMARS.  |                              |
|  | - Integrate HIMARS into RFPI evaluations.  |                              |
| • 323  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                              |
| Total  | 13232  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 4532   | - Perform 3 Guided MLRS flight tests with Inertial Measurement Unit (IMU) guidance.  |                              |
|  | - Integrate and flight test 2 Guided MLRS GPS-aided IMU.   |                              |
|  | - Transfer Guided MLRS technology to EMD.  |                              |
| • 7899   | - Complete HIMARS design.  |                              |
|  | - Fabricate HIMARS residual hardware.  |                              |
|  | - Test HIMARS hardware prior to firings, including electromagnetic testing, road tests, and man rating.  |                              |
|  | - Test firings of HIMARS at White Sands Missile Range, including range costs.  |                              |
| Total  | 12431  |                              |
| <b>FY 1999 Planned Program:</b>                                |  |                              |
| • 4780   | - Provide maintenance, spares, replacements, and repairs for HIMARS residuals, to be evaluated by the user as a part of the Rapid Force Projection Initiative. |                              |
|  | - Provide Improved Position Determining System (IPDS) retrofit kits for residual hardware.   |                              |
|  | - Provide government furnished equipment to contractor.  |                              |
| 4000   | - Provide support for interim HIMARS maintenance facility.   |                              |
| Total  | 8780   |                              |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)</b>   |  | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D380</b> |                |                |
| <br><b>B. Project Change Summary</b>   |  |                               |                |                |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 3675   | 5515                          | 8660           | 6882           |
| Appropriated Value   | 3779   | 13232                         |                |                |
| Adjustments to Appropriated Value  | -197   |                               |                |                |
| FY 1998 President's Budget Request   | 3582   | 13232                         | 12431          | 8780           |
| <p>Change Summary Explanation: Funding: FY 1997- Funding increased by Congress (+7717) for risk reduction activities leading to Guided MLRS Engineering and Manufacturing Development.<br/>         FY 1998- Funding (+3771) increased to support risk reduction activities and transition to EMD.<br/>         FY 1999- Funding (+1898) increased to provide residual support for HIMARS.</p> |  |                               |                |                |
| <p>Project D380 <span style="float: right;">Page 11 of 28 Pages</span> <span style="float: right;">Exhibit R-2 (PE 0603313A)</span></p>  |  |                               |                |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                            |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D387</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D387 Multi-Purpose Individual Munition  | 4907              | 625                 | 0                          | 0  | 0                   | 0                   | 0                         | 0                            | 0                             | 5532       |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 FY 97 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 FY 97. Work is performed by the Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL. The major contractor is Loral Aeronautic, Rancho Santa Margarita, CA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3168 - Completed system hardware fabrication and testing.</li> <li>• 1739 - Completed technology demonstration.             <ul style="list-style-type: none"> <li>- Completed accuracy and lethality evaluation.</li> <li>- Conducted milestone review for entry into engineering and manufacturing development (EMD).</li> </ul> </li> </ul> <p>Total 4907</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 610 - Issue Request For Proposal (RFP) for low-cost guidance.             <ul style="list-style-type: none"> <li>- Conduct a study to identify high cost items to address producibility.</li> <li>- Transition to engineering and manufacturing development.</li> </ul> </li> <li>15 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 625</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> |                   |                     |                            |  |                     |                     |                           |                              |                               |            |
| Project D387  |                   |                     | <i>Page 12 of 28 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0603313A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                       |                           |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D387</b> |                       |                           |
| <b><u>B. Project Change Summary</u></b>  | <b><u>FY 1996</u></b>  | <b><u>FY 1997</u></b>         | <b><u>FY 1998</u></b> | <b><u>FY 1999</u></b>     |
| FY 1997 President's Budget   | 4450   | 813                           | 0                     | 0                         |
| Appropriated Value   | 4575   | 625                           |                       |                           |
| Adjustments to Appropriated Value  | 332  |                               |                       |                           |
| FY 1998 President's Budget   | 4907   | 625                           | 0                     | 0                         |
| <br>Change Summary Explanation: Funding: FY 1997 (-188) funds redirected to Congressionally mandated Hydra-70 product improvement program. |  |                               |                       |                           |
|  |  |                               |                       |                           |
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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                            |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D486</b> |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D486 Rapid Force Projection Simulation   | 5627              | 7656                | 8390                       | 5111   | 0                   | 0                   | 0                         | 0                            | 0                             | 26784      |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 analyses will be performed under the guidance and supervision of the Integrated Battlefield Simulation and Analysis Team (IBSAT). Simulations and analyses will support the determination of value-added proposed technologies for the RFPI ACTD and will be utilized to determine the mix and number of developmental sensors to be used in the Advanced Warfighting Experiment (AWE) and subsequently to determine residual quantities and support requirements. Work is performed by the 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3340 - Performed record runs, document and staff run matrices for BEWSS, JANUS, and CASTFOREM.             <ul style="list-style-type: none"> <li>- Completed EFOG-M Virtual Prototype Demonstration (VPD) AWE and Anti-Armor ATD experiment number six.</li> </ul> </li> <li>• 2287 - Completed integration follow-on scenarios into BEWSS, JANUS, and CASTFOREM.             <ul style="list-style-type: none"> <li>- Provided real/virtual integration support.</li> </ul> </li> </ul> <p>Total 5627</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7468 - Document results of BEWSS, CASTFOREM, and JANUS runs.             <ul style="list-style-type: none"> <li>- Perform BEWSS record runs Command and Control (C2) simulations.</li> <li>- Execute ACTD and prepare for BLWE virtual exercise.</li> <li>- Perform final predictions for ACTD Model-Test-Model.</li> </ul> </li> <li>188 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 7656</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1320 - Modify draft Ft. Benning scenarios for virtual rehearsal experiment to accommodate field elements.             <ul style="list-style-type: none"> <li>- Refine Ft. Benning terrain database.</li> </ul> </li> </ul> |                   |                     |                            |  |                     |                     |                           |                              |                               |            |
| Project D486   |                   |                     | <i>Page 14 of 28 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0603313A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|------------------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D486</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 1920 - Perform post-rehearsal model-experiment-model runs and analysis.</li> <li>• 1920 - Perform final modifications to manned simulations.</li> <li>• 1800 - Use manned simulators and semi-automated forces to provide rehearsal of ACTD experiment.</li> <li>• 1800 - Perform final real/virtual hardware integration.</li> <li>• 3000 - Integrate, prepare and execute ACTD experiment.</li> <li>• 350 - Perform CASTFOREM tradeoff runs.</li> </ul> <p>Total 8390</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1000 - Provide virtual simulation resources to support real/virtual experiments during the residual period.</li> <li>• 1600 - Apply RFPI technologies to excursion scenarios to include urban, varying terrain, weather, and countermeasures.</li> <li>• 1600 - Perform post ACTD model-experiment-model runs and analysis.</li> <li>• 1600 - Perform excursion runs and analysis.</li> <li>• 1800 - Provide support for manned simulator residual.</li> <li>• 711 - Perform final cost and operational effectiveness analysis (COEA).</li> </ul> <p>Total 5111</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">5772</td> <td style="text-align: center;">7849</td> <td style="text-align: center;">8405</td> <td style="text-align: center;">5115</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">5945</td> <td style="text-align: center;">7656</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-318</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 President's Budget Request</td> <td style="text-align: center;">5627</td> <td style="text-align: center;">7656</td> <td style="text-align: center;">8390</td> <td style="text-align: center;">5111</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 5772 | 7849 | 8405 | 5115 | Appropriated Value | 5945 | 7656 |  |  | Adjustments to Appropriated Value | -318 |  |  |  | FY 1998 President's Budget Request | 5627 | 7656 | 8390 | 5111 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |
| FY 1997 President's Budget   | 5772   | 7849                          | 8405           | 5115           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |
| Appropriated Value   | 5945   | 7656                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |
| Adjustments to Appropriated Value  | -318   |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |
| FY 1998 President's Budget Request   | 5627   | 7656                          | 8390           | 5111           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |
| Project D486   | Page 15 of 28 Pages  | Exhibit R-2 (PE 0603313A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |      |  |  |  |                                    |      |      |      |      |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D493</b> |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D493 Rapid Force Projection Demonstration   | 16537             | 23737               | 29682               | 27772  | 13513               | 11317               | 0                         | 0                            | 0                             | 112558     |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 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 to 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 FORSCOM Unit, and the Depth and Simultaneous Attack Battle Lab (D&amp;SA BL). The lightweight and Highly Mobile Artillery Rocket and Missile System (HIMARS) rocket firing platform, which uses a wheeled chassis, will be a Corps asset which is attached to the Maneuver Brigade. The deployability of the 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. Integrated demonstration 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 8420 - Provided support equipment for demonstration.             <ul style="list-style-type: none"> <li>- Finalized HIMARS design.</li> <li>- Ordered long-lead items for HIMARS, including vehicles, launcher components, and raw materials.</li> </ul> </li> <li>• 4087 - Initiated fabrication of HIMARS prototypes/surrogates.             <ul style="list-style-type: none"> <li>- Completed verification and validation plan for DIS simulators.</li> <li>- Provided integrated technology program technical support.</li> </ul> </li> <li>• 4030 - Completed program plans and documentation.             <ul style="list-style-type: none"> <li>- Finalized communications equipment definition.</li> </ul> </li> </ul> <p>Total 16537</p> |                   |                     |                     |  |                     |                     |                           |                              |                               |            |
| Project D493  |                   |                     | Page 16 of 28 Pages |  |                     |                     | Exhibit R-2 (PE 0603313A) |                              |                               |            |

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|--|---|------------------------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  | PE NUMBER AND TITLE<br><b>0603313A Missile and Rocket Advanced Technology</b>   | PROJECT<br><b>D493</b>       |
| <b>FY 1997 Planned Program:</b>                                |   |                              |
| •  | 6700 - Continue HIMARS design.<br>- Initiate developmental testing of HIMARS.<br>- Continue fabrication of HIMARS prototypes/surrogates.  |                              |
| •  | 5480 - Integrate ATD/TD systems into RFPI System-of-Systems.<br>- Conduct and complete captive flight tests of sensors.   |                              |
| •  | 10977 - Perform training and integration elements at test installation.<br>- Conduct technical/operational risk reduction experiments.<br>- Procure sensor, communications equipment, and special test equipment.<br>- Conduct producibility and configuration management.    |                              |
|  | 580 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                              |
| Total  | 23737   |                              |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| •  | 9124 - Provide RFPI and Opposition Forces (OPFOR) instrumentation and support, including targets.<br>- Provide communications support for experiment, including equipment spares/TAC radios.<br>- Provide additional sensors and sensor support equipment.                    |                              |
| •  | 12000 - Develop hardware and software for special test instrumentation.<br>- Conduct user training and perform installation and checkout of System-of-Systems experiment instrumentation.<br>- Conduct Large Scale Field Experiment.<br>- Prepare for residual support.       |                              |
| •  | 8558 - Provide logistics support for ACTD.<br>- Provide support for training and troops.<br>- Provide support for residual hardware.<br>- Provide support for program evaluation and integration.   |                              |
| Total  | 29682   |                              |
| <b>FY 1999 Planned Program:</b>                                |   |                              |
| •  | 7050 - Provide maintenance, replacement parts, and spares in direct support of user units.<br>- Provide spare batteries, cables, and other replacement parts for communications equipment.<br>- Provide RFPI integrated logistics support, personnel, analysis, and training. |                              |
| Project D493   | Page 17 of 28 Pages   | Exhibit R-2 (PE 0603313A)    |

| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|-------|--|--|--|------------------------------------|-------|-------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D493</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| <p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>• 14696 - Provide training on residual equipment for experiment units.<br/>- Provide residual support for EFOG-M.<br/>- Provide residual support for hunter/killer systems and integrated acoustic system.</li> <li>• 6026 - Provide analysis and red team support including countermeasure/counter-countermeasure analysis and preparation for possible milestone review.</li> </ul> <p>Total 27772</p>   |  |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">17477</td> <td style="text-align: center;">24245</td> <td style="text-align: center;">29774</td> <td style="text-align: center;">27876</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">17967</td> <td style="text-align: center;">23737</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-1430</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 President's Budget Request</td> <td style="text-align: center;">16537</td> <td style="text-align: center;">23737</td> <td style="text-align: center;">29682</td> <td style="text-align: center;">27772</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 17477 | 24245 | 29774 | 27876 | Appropriated Value | 17967 | 23737 |  |  | Adjustments to Appropriated Value | -1430 |  |  |  | FY 1998 President's Budget Request | 16537 | 23737 | 29682 | 27772 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| FY 1997 President's Budget   | 17477  | 24245                         | 29774          | 27876          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| Appropriated Value   | 17967  | 23737                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| Adjustments to Appropriated Value  | -1430  |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| FY 1998 President's Budget Request   | 16537  | 23737                         | 29682          | 27772          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| Project D493   | Page 18 of 28 Pages  | Exhibit R-2 (PE 0603313A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D496</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D496 Enhanced Fiber Optic Guided Missile (EFOG-M)   | 55276             | 36214               | 57734               | 36605  | 14948               | 3791                | 0                         | 0                             | 0                   | 204568     |
| <p><b>A. Mission Description and Budget Item Justification: Project D496 - Enhanced Fiber Optic Guided Missile (EFOG-M):</b> The Enhanced Fiber Optic Guided Missile (EFOG-M) is the primary “killer” within the “hunter/standoff killer” concept of the Rapid Force Projection Initiative (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 plus command vehicles. 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.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2085 - Participated in a Virtual Prototype Experiment.</li> <li>• 38930 - Continued design, fabrication, and testing of EFOG-M missiles, fire units, and platoon leader vehicles for the RFPI ACTD.</li> <li>• 5094 - Initiated manufacturing of EFOG-M missiles, fire units, and platoon leader vehicles to support the Extended User Evaluation (EUE).</li> <li>• 9167 - Continued integration and management of design and fabrication effort.</li> </ul> <p>Total 55276</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7406 - Continue design, fabrication, and testing of EFOG-M missiles, fire units, and platoon leader vehicles for the RFPI ACTD.</li> <li>• 9195 - Continue manufacturing of EFOG-M missiles, fire units, and platoon leader vehicles to support the Extended User Evaluation (EUE).</li> <li>• 18749 - Continue integration and management of design and fabrication effort.</li> <li>• 864 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |
| Project D496  |                   |                     | Page 19 of 28 Pages |  |                     |                     | Exhibit R-2 (PE 0603313A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|-------|--|--|--|------------------------------------|-------|-------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D496</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| <p>Total            36214</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            41427 - Continue manufacturing of EFOG-M missiles, fire units, and platoon leader vehicles to support the Extended User Evaluation (EUE).</li> <li>•            16307 - Continue integration and management of design and fabrication effort.</li> </ul> <p>Total            57734</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>•            24327 - Continue manufacturing of EFOG-M missiles, fire units, and platoon leader vehicles to support the Extended User Evaluation (EUE) and testing.</li> <li>•            12278 - Continue integration and management of design and fabrication effort.</li> </ul> <p>Total            36605</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">60171</td> <td style="text-align: center;">37680</td> <td style="text-align: center;">57920</td> <td style="text-align: center;">36745</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">61860</td> <td style="text-align: center;">36214</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-6584</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 President's Budget Request</td> <td style="text-align: center;">55276</td> <td style="text-align: center;">36214</td> <td style="text-align: center;">57734</td> <td style="text-align: center;">36605</td> </tr> </tbody> </table> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 60171 | 37680 | 57920 | 36745 | Appropriated Value | 61860 | 36214 |  |  | Adjustments to Appropriated Value | -6584 |  |  |  | FY 1998 President's Budget Request | 55276 | 36214 | 57734 | 36605 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| FY 1997 President's Budget   | 60171  | 37680                         | 57920          | 36745          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| Appropriated Value   | 61860  | 36214                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| Adjustments to Appropriated Value  | -6584  |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| FY 1998 President's Budget Request   | 55276  | 36214                         | 57734          | 36605          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |
| Project D496   | Page 20 of 28 Pages  | Exhibit R-2 (PE 0603313A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                                    |       |       |       |       |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           |                              | PROJECT<br><b>D549</b> |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| D549 2.75 Inch Anti-Air TD   | 0                 | 0                   | 2905                | 2896  | 0                   | 0                   | 0                         | 0                            | 0                      | 5801       |
| <p><b>A. <u>Mission Description and Justification:</u></b> The objective of this project is to demonstrate the technology for a comprehensive upgrade to the STINGER missile system through the incorporation of an advanced imaging infrared seeker to enable the engagement of hostile helicopters in clutter at extended ranges (2-3x). This project will demonstrate the ability to package the previously developed commercial breadboard signal processing electronics in a 2.75 inch diameter seeker. In addition, signal processing algorithms for target detection, tracking, and IR counter-countermeasures will be developed and demonstrated via hardware in the loop simulations, ground tests, and captive carry tests. This seeker will maintain computability with existing STINGER launchers and retain STINGER's excellent capability against fixed wing aircraft.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b> Program not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1700 - Complete form-factored seeker electronics.</li> <li style="padding-left: 20px;">- Develop endgame and infrared counter-countermeasures(IRCCM) signal processing algorithms.</li> <li>• 1205 - Develop Hardware-In-the-Loop (HWIL) simulation.</li> <li style="padding-left: 20px;">- Perform acquisition and tracking tests.</li> <li style="padding-left: 20px;">- Perform IRCCM tracking tests.</li> </ul> <p>Total 2905</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1500 - Complete endgame and IRCCM signal processing algorithms.</li> <li style="padding-left: 20px;">- Develop missile guidance algorithms.</li> <li>• 1396 - Develop platform/launcher interfaces.</li> <li style="padding-left: 20px;">- Perform HWIL missile flight simulations.</li> <li style="padding-left: 20px;">- Perform captive carry air-to-air tests.</li> </ul> <p>Total 2896</p> |                   |                     |                     |   |                     |                     |                           |                              |                        |            |
| Project D549   |                   |                     | Page 21 of 28 Pages |   |                     |                     | Exhibit R-2 (PE 0603313A) |                              |                        |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |   |                |                |                |                |   |   |   |      |      |                                   |  |  |  |  |                                    |   |   |      |      |
|---|---|------------------------------|---|----------------|----------------|----------------|----------------|---|---|---|------|------|-----------------------------------|--|--|--|--|------------------------------------|---|---|------|------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   | PE NUMBER AND TITLE<br><b>0603313A Missile and Rocket Advanced Technology</b> | PROJECT<br><b>D549</b>       |   |                |                |                |                |   |   |   |      |      |                                   |  |  |  |  |                                    |   |   |      |      |
| <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><b><u>B. Project Change Summary</u></b></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget Appropriated Value</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">2901</td> <td style="text-align: center;">2890</td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 President's Budget Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">2901</td> <td style="text-align: center;">2890</td> </tr> </tbody> </table> |   |                              | <b><u>B. Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget Appropriated Value | 0 | 0 | 2901 | 2890 | Adjustments to Appropriated Value |  |  |  |  | FY 1998 President's Budget Request | 0 | 0 | 2901 | 2890 |
| <b><u>B. Project Change Summary</u></b>   | <u>FY 1996</u>  | <u>FY 1997</u>               | <u>FY 1998</u>                          | <u>FY 1999</u> |                |                |                |   |   |   |      |      |                                   |  |  |  |  |                                    |   |   |      |      |
| FY 1997 President's Budget Appropriated Value   | 0   | 0                            | 2901                                    | 2890           |                |                |                |   |   |   |      |      |                                   |  |  |  |  |                                    |   |   |      |      |
| Adjustments to Appropriated Value   |   |                              |   |                |                |                |                |   |   |   |      |      |                                   |  |  |  |  |                                    |   |   |      |      |
| FY 1998 President's Budget Request  | 0   | 0                            | 2901                                    | 2890           |                |                |                |   |   |   |      |      |                                   |  |  |  |  |                                    |   |   |      |      |
| Project D549  | <i>Page 22 of 28 Pages</i>  | Exhibit R-2 (PE 0603313A)    |   |                |                |                |                |   |   |   |      |      |                                   |  |  |  |  |                                    |   |   |      |      |

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|---|----------------|------------------|---------------------|---|------------------|------------------|---------------------------|------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                |                  |                     | PE NUMBER AND TITLE<br><b>0603313A Missile and Rocket Advanced Technology</b> |                  |                  |                           | PROJECT<br><b>D550</b> |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate    | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate       | Cost to Complete | Total Cost |
| D550 Counter Active Protection System   | 0              | 1                | 1941                | 4408  | 5467             | 0                | 0                         | 0                      | 0                | 11817      |
| <p><b>A. Mission Description and Justification:</b> This project will develop and demonstrate technologies which can be applied to Anti Tank Guided Weapons (ATGW) for improving their effectiveness against threat armor equipped with active protection systems (APS). Current technology development is concentrated in the following areas: Radio Frequency (RF) Countermeasure (RFCM) technology for jamming or deceiving APS sensors used for detection, acquisition, and tracking; warhead integration and ballistic hardening of ATGW to reduce vulnerability to fragment impact.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1 - Plan FY98 program.</li> </ul> <p>Total 1</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1941 - Perform dynamic demonstration of integrated long standoff warhead in missile structures and flight conditions. <ul style="list-style-type: none"> <li>- Design and breadboard dual band threat RFCM concept and design wide band RFCM concept.</li> <li>- Upgrade test bed radar to emulate APS at dual bands.</li> <li>- Build and test components of deployable decoy countermeasure technology.</li> </ul> </li> </ul> <p>Total 1941</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2000 - Award BAA contract for developing Long Standoff Precursor Warhead technology. <ul style="list-style-type: none"> <li>- Adapt U.S. Army Research Laboratory RF signature reduction and modification techniques for use on missiles with homing seekers.</li> </ul> </li> <li>• 2408 - Construct breadboard wideband RFCM concept and test against APS threat radars and other postulated threats. <ul style="list-style-type: none"> <li>- Perform flight demonstration of deployable decoy countermeasure system.</li> </ul> </li> </ul> <p>Total 4408</p> |                |                  |                     |   |                  |                  |                           |                        |                  |            |
| Project D550  |                |                  | Page 23 of 28 Pages |   |                  |                  | Exhibit R-2 (PE 0603313A) |                        |                  |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                           |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D550</b> |                |                           |
| <b><u>B. Project Change Summary</u></b>   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u>            |
| FY 1997 President's Budget  | 0  | 1942                          | 1934           | 2409                      |
| Appropriated Value  |  | 1                             |                |                           |
| Adjustments to Appropriated Value   |  |                               |                |                           |
| FY 1998 President's Budget Request  | 0  | 1                             | 1941           | 4408                      |
| <p>Change Summary Explanation: Funding: FY 1997- (-1941) funds redirected to congressionally mandated Hydra-70 product improvement program.<br/>                     FY 1999 Funding increased (+1999) to allow for demonstration of advanced RFCM concept and conduct testing against APS threat radars.</p> |  |                               |                |                           |
|   |  |                               |                |                           |
| Project D550  |  | Page 24 of 28 Pages           |                | Exhibit R-2 (PE 0603313A) |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                            |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                            | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>D567</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate        | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D567 LCPK for 2.75 Inch Rockets   | 0                 | 0                   | 0                          | 517  | 5489                | 3944                | 0                         | 0                             | 0                   | 9950       |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides for demonstration of a low cost, accurate (1-m CEP) guidance and control retrofit package for the 2.75-inch Hydra-70 rocket that provides a stand-off range (<math>\geq 6</math> km) capability against specified non-tank point targets. This capability will provide for a high single shot probability of hit (<math>Ph \geq 0.7</math>) against the long range target, exceeding the current unguided 2.75-inch rocket baseline by 1 or 2 orders of magnitude and thereby providing a 4 to 1 increase in stowed kills at one third the cost per kill compared to current guided missiles. The resulting decrease in logistics burden is of significant benefit to a CONUS-based force projection Army and of particular importance in a rapid force projection scenario. In addition, the increased accuracy will minimize collateral damage, reduce risk of fratricide, and will reduce mission times and sorties resulting in increased system survivability. Two separate retrofit guidance package approaches, one based on a solid state (strapdown) mechanization of semi-active laser (SAL) guidance, and the other, based on a potentially much lower cost innovative laser beam follower mode of guidance denoted Scatterider, will be developed and tested in parallel, with user participation, to assure the most cost effective solution is obtained in the neckdown to one system for the transition to EMD. The tests will demonstrate technologies and techniques to overcome barriers such as: providing a low cost, producible strapdown mechanism for precision guidance; robust design for rolling airframe applications; component packaging in 2.75 - inch airframe; structural, vibration and shock considerations for guidance package retrofit to current 2.75 - inch Hydra-70 rockets; and stand-off range target acquisition and engagement techniques to address current free-rocket launch and flight dispersions. Work is performed by the Research, Development, and Engineering Center, U. S. Army Missile Command, Redstone Arsenal, AL. All of the effort for the Scatterider demonstration will be performed in-house, while the strapdown SAL will be accomplished in conjunction with a major contractor to supply the guidance section and support for the demonstrations.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 317 - Initiate in-house design of flight test hardware to evaluate the scatterider concept.</li> <li>• 100 - Issue RFP for demonstration hardware and live fire test support to evaluate the strapdown SAL concept.</li> <li>• 100 - Develop flight demonstration test plan.</li> </ul> <p>Total 517</p> |                   |                     |                            |  |                     |                     |                           |                               |                     |            |
| Project D567  |                   |                     | <i>Page 25 of 28 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0603313A) |                               |                     |            |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D567</b> |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                                    |   |   |   |     |  |  |
| <p><b><u>B. Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget Appropriated Value</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 President's Budget Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">517</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: This program is a new start for FY 1999.</p> |  | <u>FY 1996</u>                | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget Appropriated Value | 0 | 0 | 0 | 0 | Adjustments to Appropriated Value |  |  |  |  | FY 1998 President's Budget Request | 0 | 0 | 0 | 517 |  |  |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |   |   |   |   |   |                                   |  |  |  |  |                                    |   |   |   |     |  |  |
| FY 1997 President's Budget Appropriated Value  | 0  | 0                             | 0              | 0              |                |   |   |   |   |   |                                   |  |  |  |  |                                    |   |   |   |     |  |  |
| Adjustments to Appropriated Value  |  |                               |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                                    |   |   |   |     |  |  |
| FY 1998 President's Budget Request   | 0  | 0                             | 0              | 517            |                |   |   |   |   |   |                                   |  |  |  |  |                                    |   |   |   |     |  |  |
| Project D567   | Page 26 of 28 Pages  | Exhibit R-2 (PE 0603313A)     |                |                |                |   |   |   |   |   |                                   |  |  |  |  |                                    |   |   |   |     |  |  |



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|--|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> |                     |                           |                     | <b>PROJECT</b><br><b>D703</b> |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D703 Hydra-70 Rocket PIP   | 0                 | 8812                | 0                   | 0  | 0                   | 0                         | 0                   | 0                             | 0                   | 8812       |
| <p><b>A. <u>Mission Description and Justification:</u></b> This is a Congressionally mandated program. The objective of this project is to demonstrate and qualify a new rocket motor for the Hydra-70 free flight rocket weapon system. The following conditions on this qualification program were mandated by Congress:</p> <ol style="list-style-type: none"> <li>1. The rocket motor shall utilize composite propellant.</li> <li>2. The rocket motor shall be a non-developmental item (NDI).</li> <li>3. A Technical Data Package (TDP) detailing the design of the rocket motor shall be delivered.</li> <li>4. The rocket motor shall be a form-fit-function replacement for MK-66 motor that is currently in production.</li> <li>5. The rocket motor shall be certified for air worthiness on the AH-64 Apache Helicopter.</li> </ol> <p>To fully comply with the Congressional Direction, the program will be executed in three self-contained and distinct Phases which are described as follows: Phase I consists primarily of source selection activities. Under this effort, a Request for Proposals (RFP) was issued which included a performance specification that was consistent with the program objectives and constraints. Utilizing this RFP, multiple contracts (4) were awarded to prospective rocket motor manufacturers. Under the Phase I effort each contractor was required to deliver 25 rocket motors each. The government conducts a limited qualification evaluation on each of the four motors designs, including environmental and static performance testing. The results of this limited test program are utilized to select a single vendor for the remainder of the qualification effort. Phase II is full ground qualification of the single down-selected rocket motor design. This effort includes a complete series of environmental, insensitive munitions, and static performance tests. Also included are a complete series of flight tests from a ground launcher that shall determine flight performance and launcher compatibility. Approximately 500 rocket motor firings will be conducted (150 static and 350 flights). Phase III is flight qualification on the AH-64 Apache. Approximately 2000 rocket motors will be launched off the Apache to demonstrate full compatibility with the launch platform. With the conclusion of Phase III, the rocket motor will be fully qualified for air worthiness on the AH-64.</p> <p><b>FY 1996 Accomplishments:</b> Congressionally mandated program, funded in PE 0203802A, Other Missile Product Improvement Programs.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4000 Procure 2000 non-developmental Item (NDI) rocket motors for qualification testing.</li> <li>• 2200 Acquire AH-64 helicopter test articles and associated test hardware.</li> <li>• 2397 Conduct airworthiness certification test flights from AH-64 helicopter.</li> <li>• 215 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 8812</p> |                   |                     |                     |  |                     |                           |                     |                               |                     |            |
| Project D703   |                   | Page 27 of 28 Pages |                     |  |                     | Exhibit R-2 (PE 0603313A) |                     |                               |                     |            |

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|--|--|-------------------------------|---|----------------|----------------|----------------|----------------|-----------------------------|--|--|--|--|--------------------|--|------|--|--|-----------------------------------|--|--|--|--|------------------------------------|--|------|--|--|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603313A Missile and Rocket Advanced Technology</b> | <b>PROJECT</b><br><b>D703</b> |   |                |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |
| <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p>  |  |                               |   |                |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |
| <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><b><u>B. Project Change Summary</u></b></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>Previous President's Budget</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Appropriated Value</td> <td></td> <td style="text-align: center;">8812</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 President's Budget Request</td> <td></td> <td style="text-align: center;">8812</td> <td></td> <td></td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: This is a Congressionally mandated program.</p> |  |                               | <b><u>B. Project Change Summary</u></b> | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | Previous President's Budget |  |  |  |  | Appropriated Value |  | 8812 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 President's Budget Request |  | 8812 |  |  |
| <b><u>B. Project Change Summary</u></b>  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u>                          | <u>FY 1999</u> |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |
| Previous President's Budget  |  |                               |   |                |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |
| Appropriated Value   |  | 8812                          |   |                |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |
| Adjustments to Appropriated Value  |  |                               |   |                |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |
| FY 1998 President's Budget Request   |  | 8812                          |   |                |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |
| Project D703   | Page 28 of 28 Pages  | Exhibit R-2 (PE 0603313A)     |   |                |                |                |                |                             |  |  |  |  |                    |  |      |  |  |                                   |  |  |  |  |                                    |  |      |  |  |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)           |                   |                     |                     |   |                     |                     |                     | DATE<br>February 1997 |                     |            |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------|-----------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b> |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603606A Landmine Warfare and Barrier<br/>Advanced Technology</b> |                     |                     |                     |                       |                     |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate   | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost                               | 25006             | 27629               | 19332               | 19778   | 19656               | 19249               | 20473               | 21065                 | Continuing          | Continuing |
| D608 Countermine & Barrier Development                        | 19312             | 22734               | 19332               | 19778   | 19656               | 19249               | 20473               | 21065                 | Continuing          | Continuing |
| D624 Ground Penetrating Radar Technology                      | 2850              | 4895                | 0                   | 0   | 0                   | 0                   | 0                   | 0                     | 0                   | 7745       |
| D660 Land Mine Detection and Clearing                         | 2844              | 0                   | 0                   | 0   | 0                   | 0                   | 0                   | 0                     | 0                   | 2844       |

**Mission Description and Budget Item Justification:** This program element provides for the development and demonstration of countermine technologies, and a Congressional special interest effort to test and evaluate commercial technologies to support humanitarian demining operations. Advanced technology demonstrations (ATDs), advanced warfighting experiments, and modeling and simulation will be conducted to verify the system of systems approach, providing support for the shallow water/beach/land assault phase (Demo 1) of the Navy, Army, and USMC joint countermine advanced concept 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 will be developed for both conventional and electronically activated mines that can act at a distance. Operation Desert Storm and the humanitarian operations in Somalia have highlighted the need for new equipment to detect and neutralize land mines. The Army's highest priority requirements are in-stride detection and breaching, and man-portable stand-off and close-in detection and neutralization of landmines. Multi-sensor fusion will be used in vehicle-mounted mine detectors and airborne multispectral minefield detectors 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. The work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on conventional air/surface weapons and ground vehicles. Work in this program element is related to and fully coordinated with PE 0603691A (Landmine Warfare and Barrier Advanced Development), PE 0602784A (Military Engineering Technology), PE 0602712A (Countermine Technology), and PE 0602709A (Night Vision and Electro-Optics Technology). This program is managed primarily by the Communications-Electronics Research, Development and Engineering Center (CERDEC), Night Vision Electronic Sensors Directorate (NVESD), Fort Belvoir, VA. 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.

|  |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
|--|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603606A Landmine Warfare and Barrier<br/>Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>D608</b>       |                     |            |
| COST <i>(In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| D608 Countermine & Barrier Development   | 19312             | 22734               | 19332               | 19778   | 19656               | 19249               | 20473                     | 21065                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project provides advanced technology demonstrations of countermine capabilities. The specific efforts include remote detection of minefields, detection of individual mines from moving vehicles and advanced hand held detectors, all of which must work against both traditional (metallic) mines and mines made from advanced materials. Multi-sensor fusion will be used in vehicle-mounted mine detectors and airborne multispectral minefield detectors to sense surface-laid and buried mines. Advanced signature projection and electronic deception techniques will be developed and demonstrated to defeat off-route, smart mines. A new generation of stand-off sensors and explosive/directed energy mine neutralization technologies will be integrated in a Mine Hunter/Killer that will be capable of detecting and destroying mines at maneuver speeds. These advanced technology demonstrations, along with advanced warfighting experiments and modeling and simulation represent key elements of the shallow water/beach/land assault phase of the Navy, Army, and USMC joint countermine advanced concept technology demonstration (ACTD).</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 7633 – Successfully demonstrated off route smart mine clearance techniques to defeat terminal sensors of side attack mines;             <ul style="list-style-type: none"> <li>– Transitioned performance specifications and technical data to support limited procurement of side attack countermeasures for contingency operations.</li> <li>– Completed sensor fusion algorithms; initiated build and integration of hardware and software for vehicle mounted mine detector demonstration.</li> </ul> </li> <li>• 11679 – Conducted "expand the lodgment" and "beach break through" advanced warfighting demonstrations.             <ul style="list-style-type: none"> <li>– Completed phase I of joint countermine advanced concept technology demonstration (ACTD) modeling and simulation effort.</li> <li>– Completed procurement of multiple manportable, vehicle mounted, and airborne mine detection prototypes.</li> <li>– Defined countermine command, control, communications, computers, and intelligence (C4I) requirements and architecture and procured C4I equipment for Joint Countermine ACTD.</li> </ul> </li> </ul> <p>Total 19312</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 8247 – Conduct "movement to contact" countermine modeling and simulation studies and small scale countermine field experiments.             <ul style="list-style-type: none"> <li>– Complete simulation, analysis, and pre-demonstration exercises of countermine C4I architecture; conduct ACTD demonstration I at Camp Lejeune, NC in conjunction with United States Atlantic Command (USACOM) forces.</li> </ul> </li> <li>• 6215 – Complete development of forward looking infrared and down looking ground penetrating radar sensors for vehicular mounted mine detector.             <ul style="list-style-type: none"> <li>– Evaluate alternative multisensor approaches for vehicular mounted mine detector.</li> </ul> </li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project D608   |                   |                     | Page 2 of 6 Pages   |   |                     |                     | Exhibit R-2 (PE 0603606A) |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |   | DATE<br><b>February 1997</b> |
|--|---|------------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE   | PROJECT                      |
| <b>3 - Advanced Technology Development</b>                     | <b>0603606A Landmine Warfare and Barrier<br/>Advanced Technology</b>  | <b>D608</b>                  |
| <b>FY 1997 Planned Program (continued):</b>                    |   |                              |
| • 7717   | – Initiate development efforts to improve maturity of vehicular mounted mine detector prototypes.<br>– Integrate forward looking sensor to one prototype to provide three systems with comparable capabilities.<br>– Implement sensor fusion of forward looking and down looking sensors on all three prototypes.   |                              |
| • 555  | – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                              |
| Total  | 22734   |                              |
| <b>FY 1998 Planned Program:</b>                                |   |                              |
| • 8735   | – Conduct movement to contact Battle Lab experiment and assess contribution of new countermine technology to survivability of convoy/rear area assets.<br>– Analyze data from Joint Countermine ACTD Demo I, apply lessons learned to Demo II planning, and execute Demo II. Receive interim user report on novel system military suitability.<br>– Add fidelity to Joint Countermine ACTD novel system models and conduct sensitivity studies; complete modeling of false targets for detection systems and transition to joint countermine operational simulation. Continue validation and verification activities. |                              |
| • 3000   | – Complete development of three vehicular mounted mine detector prototypes with alternative multisensor fusion design approaches, conduct comparative performance testing, and select system(s) for final technology demonstration.<br>– Transition program design and test documentation to Ground Stand-off Mine Detection System demonstration/validation.   |                              |
| • 7597   | – Complete fabrication of precision mine location, aimpoint estimator, fire control, and neutralization technologies for the Mine Hunter/Killer and complete plans for demonstration execution.<br>– Complete development of advanced stand-off ground penetrating radar (GPR) sensor to allow greater standoff mine detection distances and faster forward speeds. Fabricate prototype stand-off GPR for integration with Mine Hunter/Killer demonstrator.   |                              |
| Total  | 19332   |                              |
| <b>FY 1999 Planned Program:</b>                                |   |                              |
| • 7693   | – Conduct Assault on Objective Battle Lab experiment and assess contribution of new countermine technology to survivability and mobility of assault forces.<br>– Analyze data from Joint Countermine ACTD Demo II, apply lessons learned to technology programs and provide support for residual hardware. Receive final user report on novel system military suitability.<br>– Develop models and simulations for Joint Countermine ACTD technologies and integrate into service models with new architecture; continue verification and validation.   |                              |
| Project D608   |   |                              |
| Page 3 of 6 Pages  |   |                              |
| Exhibit R-2 (PE 0603606A)                                      |   |                              |

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|-------------------------|-------|-------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603606A Landmine Warfare and Barrier<br/>Advanced Technology</b> | <b>PROJECT</b><br><b>D608</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| <p><b>FY 1999 Planned Program (continued):</b></p> <ul style="list-style-type: none"> <li>• 12085 – Integrate prototype detection and neutralization technologies on Mine Hunter/Killer platform, complete contractor testing and complete site preparation for the Mine Hunter/Killer demonstration.</li> <li>– Complete requirements analysis, definition of aircraft constraints and interfaces, and technology trade-offs for imaging multispectral airborne minefield detection system.</li> </ul> <p>Total 19778</p>   |  |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">18251</td> <td style="text-align: center;">15196</td> <td style="text-align: center;">16386</td> <td style="text-align: center;">14047</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">18820</td> <td style="text-align: center;">22734</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+492</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">19312</td> <td style="text-align: center;">22734</td> <td style="text-align: center;">19332</td> <td style="text-align: center;">19778</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 - Congressional increase (+7538) for vehicular mounted mine detector.<br/> FY 1998/FY 1999 - Funding increased in FY1998 (+2946) and FY1999 (+5731) to address high priority requirements for mine detection and neutralization.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 18251 | 15196 | 16386 | 14047 | Appropriated Value | 18820 | 22734 |  |  | Adjustments to Appropriated Value | +492 |  |  |  | FY1998 Pres Bud Request | 19312 | 22734 | 19332 | 19778 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| FY 1997 President's Budget   | 18251  | 15196                         | 16386          | 14047          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| Appropriated Value   | 18820  | 22734                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| Adjustments to Appropriated Value  | +492   |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| FY1998 Pres Bud Request  | 19312  | 22734                         | 19332          | 19778          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |
| Project D608   | Page 4 of 6 Pages  | Exhibit R-2 (PE 0603606A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |       |       |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|--------------------------|------|------|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603606A Landmine Warfare and Barrier<br/>Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>D624</b>       |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| D624 Ground Penetrating Radar Technology  | 2850              | 4895                | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                   | 7745       |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> This Congressional special interest program provides for the development and evaluation of stand-off ground penetrating radar (GPR) technologies for mine detection.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2850 - Investigated detection algorithm and waveform improvements to stand-off ground penetrating radar technologies for manportable and vehicle mine detection applications.</li> </ul> <p>Total 2850</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4775 - Test and evaluate detection algorithm enhancements and develop improved transmitter/receiver and waveform for stand-off GPR.<br/>- Transition stand-off GPR technologies to Mine Hunter/Killer ATD.</li> <li>• 120 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 4895</p> <p><b>FY 1998 Planned Program:</b> Project funded in PE 0603606A (Landmine Warfare and Barrier Advanced Technology) /D608.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1996</u></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2918</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3000</td> <td style="text-align: center;">4895</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-150</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">2850</td> <td style="text-align: center;">4895</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997 funding provided by Congress (+4895) to support development of GPR technologies.</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2918 | 0 | 0 | 0 | Appropriated Value | 3000 | 4895 |  |  | Adjustments to Appropriated Value | -150 |  |  |  | FY 1998 Pres Bud Request | 2850 | 4895 | 0 | 0 |
|   | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>  |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1997 President's Budget  | 2918              | 0                   | 0                   | 0   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Appropriated Value  | 3000              | 4895                |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Adjustments to Appropriated Value   | -150              |                     |                     |   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| FY 1998 Pres Bud Request  | 2850              | 4895                | 0                   | 0   |                     |                     |                           |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |
| Project D624  |                   |                     | Page 5 of 6 Pages   |   |                     |                     | Exhibit R-2 (PE 0603606A) |                              |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |      |  |  |                                   |      |  |  |  |                          |      |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
|--|-------------------|---------------------|---------------------|--|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|------|---|---|---|--------------------|------|--|--|--|-----------------------------------|------|--|--|--|-------------------------|------|---|---|---|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603606A Landmine Warfare and Barrier<br/>Advanced Technology</b> |                     |                           |                     | <b>PROJECT</b><br><b>D660</b> |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| D660 Land Mine Detection and Clearing  | 2844              | 0                   | 0                   | 0  | 0                   | 0                         | 0                   | 0                             | 0                   | 2844       |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> This program provides for the integration and demonstration of commercial off-the-shelf technologies for use in humanitarian demining. This Congressional special interest program is a continuation of an effort funded in FY1995 under project D608 in PE 0603606A (Landmine Warfare and Barrier Advanced Technology). FY1997 funding for humanitarian demining technology is programmed in DoD PE 0603120D (Demining).</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2844 – Developed and demonstrated commercial technologies for land mine detection and clearance in support of military support and sustainment operations.</li> <li>– Completed development of multilingual mine awareness and training materials for instruction of host nation deminers.</li> </ul> <p>Total 2844</p> <p><b>FY 1997 Planned Program:</b> Project not funded in FY 97.</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">2918</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">3000</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-156</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">2844</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> |                   |                     |                     |  |                     |                           |                     |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 2918 | 0 | 0 | 0 | Appropriated Value | 3000 |  |  |  | Adjustments to Appropriated Value | -156 |  |  |  | FY1998 Pres Bud Request | 2844 | 0 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>      | <u>FY 1999</u>   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| FY 1997 President's Budget   | 2918              | 0                   | 0                   | 0  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| Appropriated Value   | 3000              |                     |                     |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| Adjustments to Appropriated Value  | -156              |                     |                     |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| FY1998 Pres Bud Request  | 2844              | 0                   | 0                   | 0  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |
| Project D660   |                   |                     | Page 6 of 6 Pages   |  |                     | Exhibit R-2 (PE 0603606A) |                     |                               |                     |            |  |                |                |                |                |                            |      |   |   |   |                    |      |  |  |  |                                   |      |  |  |  |                         |      |   |   |   |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |                     |  |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603607A Joint Service Small Arms Program</b> |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate  | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 4516              | 9049                | 4754                | 5148                | 4977   | 5601                | 5955                | 6058                         | Continuing          | Continuing |
| D627 Joint Service Small Arms Program (JSSAP)  | 4516              | 8070                | 4754                | 5148                | 4977   | 5601                | 5955                | 6058                         | Continuing          | Continuing |
| D664 Advanced Lightweight Anti-Armor Weapon Sys  | 0                 | 979                 | 0                   | 0                   | 0  | 0                   | 0                   | 0                            | 0                   | 979        |
| <p><b>Mission Description and Budget Item Justification:</b> The objective of this Program Element (PE) is to demonstrate key technologies leading to more effective small arms weapons and munitions for all Services. The Joint Services Small Arms Program (JSSAP) is designed to overcome the technological barriers associated with small arms/munitions/fire control for individual and crew-served weapons. The goal is to achieve substantial improvements in threat defeat under all environmental conditions while reducing the soldier's load. All JSSAP efforts are based upon approved Joint Service Science and Technology Objectives (JSSTO) and the Joint Service Small Arms Master Plan (JSSAMP), plus Mission Needs Statements and Operational Requirements Documents of the Services. The work in this PE is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. These programs are primarily managed by the U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is related to and fully coordinated with efforts in PE 0602623A (Joint Service Small Arms Program), PE 0602624A (Weapons and Munitions Technology), and transitions to JSSAP efforts conducted in PE 0604802A (Weapons and Munitions-Engineering Development) and PE 0604601A (Objective Crew Served Weapon-Engineering Development). Additional transition paths have been established in coordination with Product Manager (PM) Small Arms, USMC Program Manager (PM) Ground Weapons and US Special Operations Command (SOCOM). 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.</p> |                   |                     |                     |                     |  |                     |                     |                              |                     |            |
| <i>Page 1 of 4 Pages</i>   |                   |                     |                     |                     | Exhibit R-2 (PE 0603607A)  |                     |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                |                  |                   |   |                  |                  |                           | DATE<br><b>February 1997</b> |                  |            |
|---|----------------|------------------|-------------------|---|------------------|------------------|---------------------------|------------------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                |                  |                   | PE NUMBER AND TITLE<br><b>0603607A Joint Service Small Arms Program</b> |                  |                  |                           | PROJECT<br><b>D627</b>       |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate  | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate          | FY 2003 Estimate             | Cost to Complete | Total Cost |
| D627 Joint Service Small Arms Program (JSSAP)   | 4516           | 8070             | 4754              | 5148  | 4977             | 5601             | 5955                      | 6058                         | Continuing       | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project funds several efforts, including the following: (1) Objective Individual Combat Weapon (OICW) Advanced Technology Demonstration (ATD) which will provide a 300% to 500% increase in hit probability, the ability to defeat defilade or non-visible targets, and increase effective range to 1000 meters; (2) Objective Crew Served Weapon (OCSW), which will demonstrate the next generation crew-served weapon to replace selected M2 machine guns and MK19 grenade machine guns (GMG), a two-soldier portable system that 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) 7.62mm long range sniper cartridge with enhanced effective range out to 1000m; (5) controlled penetration ammunition, intended to minimize collateral damage in confined operational environments; (6) training ammunition, to yield realistic training with a reduced maximum range of 2700m vs. 6500m for service ammunition; and (7) a new Joint service combat shotgun meeting the requirements of all the Services, increasing versatility, and reducing logistics burden.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3944 - Demonstrated critical sub-system component technologies for OICW; integrated sub-system components for application into system prototypes, fully utilizing integrated product and process development methodology.               <ul style="list-style-type: none"> <li>- Completed technology demonstrations of multi-platform ballistic sight and prepared for transition.</li> <li>- Completed fabrication of hardware and verified performance of Cal .50 long range training ammunition (LRTA).</li> </ul> </li> <li>• 572 - Fabricated/delivered refined low collateral damage rifle ammunition for performance verification.               <ul style="list-style-type: none"> <li>- Obtained Joint combat shotgun hardware and initiated technical tests.</li> <li>- Completed 7.62mm long range sniper cartridge performance verification, configuration documentation, and transition decision.</li> </ul> </li> </ul> <p>Total 4516</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 7200 - Refine/build/test/qualify/exercise simulator for the OICW.               <ul style="list-style-type: none"> <li>- Complete design and fabrication of OICW demonstrator weapons by two competitive contractor teams and conduct technology demonstration.</li> <li>- Downselect to single OICW contractor team.</li> </ul> </li> <li>• 688 - Verify low collateral rifle ammunition performance and produce final report.               <ul style="list-style-type: none"> <li>- Complete technical tests, complete operational test (OT) hardware, conduct OT tests and complete milestone decision for Joint combat shotgun.</li> <li>- Fabricate and demonstrate an initial prototype Objective Crew Served Weapon (OCSW).</li> </ul> </li> <li>• 182 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</li> </ul> <p>Total 8070</p> |                |                  |                   |   |                  |                  |                           |                              |                  |            |
| Project D627  |                |                  | Page 2 of 4 Pages |   |                  |                  | Exhibit R-2 (PE 0603607A) |                              |                  |            |

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|------|------|--------------------|------|------|--|--|-----------------------------------|-----|--|--|--|--------------------------|------|------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603607A Joint Service Small Arms Program</b> | <b>PROJECT</b><br><b>D627</b> |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3352 - Initiate and build complete hardware for OICW ATD.</li> <li>• 1402 - Complete initial OCSW demonstrator final prototype for safety/technical/user tests.<br/>                 - Conduct OCSW system performance demonstration at contractor's facility.<br/>                 - Deliver OCSW prototypes for government testing.</li> </ul> <p>Total            4754</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3010 - Complete OICW ATD.<br/>                 - Transition OICW to PM Small Arms for EMD.</li> <li>• 2138 - Conduct safety/technical/user tests of OCSW prototype.<br/>                 - Evaluate OCSW system performance.</li> </ul> <p>Total            5148</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">4365</td> <td style="text-align: center;">5243</td> <td style="text-align: center;">4756</td> <td style="text-align: center;">5152</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">4487</td> <td style="text-align: center;">8070</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+29</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">4516</td> <td style="text-align: center;">8070</td> <td style="text-align: center;">4754</td> <td style="text-align: center;">5148</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 funds increased (+3000) for the Objective Individual Combat Weapon Program.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 4365 | 5243 | 4756 | 5152 | Appropriated Value | 4487 | 8070 |  |  | Adjustments to Appropriated Value | +29 |  |  |  | FY 1998 Pres Bud Request | 4516 | 8070 | 4754 | 5148 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1997 President's Budget   | 4365   | 5243                          | 4756           | 5152           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Appropriated Value   | 4487   | 8070                          |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Adjustments to Appropriated Value  | +29  |                               |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| FY 1998 Pres Bud Request   | 4516   | 8070                          | 4754           | 5148           |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |
| Project D627   | Page 3 of 4 Pages  | Exhibit R-2 (PE 0603607A)     |                |                |                |                |                |                            |      |      |      |      |                    |      |      |  |  |                                   |     |  |  |  |                          |      |      |      |      |

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|--|-------------------|---------------------|--------------------------|--|---------------------|---------------------------|---------------------|-------------------------------|---------------------|------------|--|----------------|----------------|----------------|----------------|----------------------------|---|---|---|---|--------------------|--|-----|--|--|-----------------------------------|--|--|--|--|--------------------------|---|-----|---|---|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |  |                     |                           |                     | DATE<br><b>February 1997</b>  |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                          | <b>PE NUMBER AND TITLE</b><br><b>0603607A Joint Service Small Arms Program</b> |                     |                           |                     | <b>PROJECT</b><br><b>D664</b> |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate       | FY 2002<br>Estimate | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| D664 Advanced Lightweight Anti-Armor Weapon Sys  | 0                 | 979                 | 0                        | 0  | 0                   | 0                         | 0                   | 0                             | 0                   | 979        |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| <p><b>A. <u>Mission Description and Justification:</u></b> This Congressionally directed project calls for demonstration and evaluation of advanced warhead technologies that would significantly increase the individual soldier capability to attack light armored vehicles. The Army will competitively award a contract to develop and demonstrate 25mm anti-armor munitions suitable for use in the OCSW.</p> <p><b>FY 1996 Accomplishments:</b> Project not funded in FY 96.</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 955 - Provide comparative data on shaped charge and explosively formed projectile warheads in order to assess the potential of meeting light armor penetration goals of the OCSW.</li> <li>• 24 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 979</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98.</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width:100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1996</u></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td></td> <td style="text-align: center;">979</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">0</td> <td style="text-align: center;">979</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> <p>Change Summary Explanation: Funding: FY 1997 Congressional plus-up (+1000).</p> |                   |                     |                          |  |                     |                           |                     |                               |                     |            |  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 0 | 0 | 0 | 0 | Appropriated Value |  | 979 |  |  | Adjustments to Appropriated Value |  |  |  |  | FY 1998 Pres Bud Request | 0 | 979 | 0 | 0 |
|  | <u>FY 1996</u>    | <u>FY 1997</u>      | <u>FY 1998</u>           | <u>FY 1999</u>   |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| FY 1997 President's Budget   | 0                 | 0                   | 0                        | 0  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Appropriated Value   |                   | 979                 |                          |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Adjustments to Appropriated Value  |                   |                     |                          |  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| FY 1998 Pres Bud Request   | 0                 | 979                 | 0                        | 0  |                     |                           |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |
| Project D664   |                   |                     | <i>Page 4 of 4 Pages</i> |  |                     | Exhibit R-2 (PE 0603607A) |                     |                               |                     |            |  |                |                |                |                |                            |   |   |   |   |                    |  |     |  |  |                                   |  |  |  |  |                          |   |     |   |   |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603654A Line-of-Sight Technology Demonstration</b> |                     |                     |                           | <b>PROJECT</b><br><b>D460</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| D460 LOSAT Technology Demonstration   | 13396             | 9791                | 13000               | 20000  | 40000               | 55000               | 67000                     | 50000                         | 10000               | 417923     |
| <p><b>A. <u>Mission Description and Budget Item Justification:</u></b> 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 a Heavy High Mobility Multi-purpose Wheeled Vehicle (HMMWV) chassis. The current program provides for the conduct of a demonstration of the HMMWV platform and will involve flight tests and early soldier evaluations of the program. The demonstration program is a cost-effective means to assess the utility of LOSAT to the early entry force. Project objectives include transitioning from a technology demonstration program to an ACTD program in FY 1998 to position the technology for future acquisition decisions, demonstrate subsystem capabilities in flight tests and a dirty battlefield environment, evaluate the utility of the LOSAT technology for the early entry forces, demonstrate an integrated HMMWV-based LOSAT system in flight test and advanced warfighting experiments, and evaluate affordability issues. 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 close combat anti-armor weapon system (CCAWS) Project Office in Huntsville, AL. The prime contractor is Lockheed Martin-Vought Systems in Dallas, TX.</p> <p><b>Acquisition Strategy:</b> The LOSAT weapon system provides the Army's early entry force an air mobile, leap-ahead technology, anti-tank weapon system providing overmatching armor lethality with no known countermeasures. The LOSAT KE missile and associated fire control system utilize unique and innovative technologies and resulted in a sole source development contract awarded to prime contractor Lockheed Martin-Vought Systems in Dallas, Texas. Funding in FY 1998 of \$13.0M supports the completion of the technology demonstration effort and the beginning of the ACTD program.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4344 - Completed AGS chassis fabrication/stopped work on AGS fire unit development effort.</li> <li>• 7423 - Completed initial technical demonstration of LOSAT missile assembly and flight test.</li> <li>• 1032 - Completed initial LOSAT/HMMWV feasibility and concept studies.</li> <li>• 362 - Successfully conducted LOSAT/HMMWV launch effects test.</li> <li>• 20 - Successfully conducted a C-130 roll-on/roll-off demonstration.</li> <li>• 215 - Completed distributed interactive simulation crew station simulator (DISCSS) experiments.</li> </ul> <p>Total 13396</p> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |
| Project D460  |                   |                     | Page 1 of 3 Pages   |  |                     |                     | Exhibit R-2 (PE 0603654A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603654A Line-of-Sight Technology Demonstration</b> | <b>PROJECT</b><br><b>D460</b> |
| <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 157 - Conduct LOSAT/HMMWV early soldier evaluation at Fort Benning, GA (Infantry School).</li> <li>• 1722 - Develop LOSAT weapon system performance requirements.</li> <li>• 4104 - Define requirements/initiate missile electronics design/test including inertial measurement unit.</li> <li>• 1151 - Prepare/conduct missile software requirements definition and analysis.</li> <li>• 996 - Update LOSAT system simulation pertaining to the new missile guidance electronics.</li> <li>• 1422 - Define requirements/initiate design of fire unit.</li> <li>• 239 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 9791</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1775 - Develop/test missile software.</li> <li>• 2610 - Design/fabricate, missile hardware, conduct hardware-in-the-loop tests.</li> <li>• 2390 - Initiate fire unit software development.</li> <li>• 3615 - Continue fire unit analysis and design.</li> <li>• 2610 - Continue missile analysis and design.</li> </ul> <p>Total 13000</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5525 - Continue development and test of fire unit/missile software.</li> <li>• 4114 - Continue missile design/test, and initiate material purchases.</li> <li>• 3535 - Continue fire unit design, test, and initiate material purchases.</li> <li>• 1471 - Initiate hardware-in-the-loop/closed loop simulation evaluation/verification of new hardware/software design.</li> <li>• 5355 - Initiate design/fabrication of prototype tooling and test equipment.</li> </ul> <p>Total 20000</p> |  |                               |
| Project D460  | Page 2 of 3 Pages  | Exhibit R-2 (PE 0603654A)     |

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|---|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|---|--------------------|-------|-------|--|--|-----------------------------------|-------|------|--|--|--------------------------|-------|------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603654A Line-of-Sight Technology Demonstration</b> | <b>PROJECT</b><br><b>D460</b> |                |                |                |                |                |                            |       |       |       |   |                    |       |       |  |  |                                   |       |      |  |  |                          |       |      |       |       |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%;"></th> <th style="width: 12.5%; text-align: center;"><u>FY 1996</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1997</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1998</u></th> <th style="width: 12.5%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">14384</td> <td style="text-align: center;">18173</td> <td style="text-align: center;">12998</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">14727</td> <td style="text-align: center;">10000</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-1331</td> <td style="text-align: center;">-209</td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">13396</td> <td style="text-align: center;">9791</td> <td style="text-align: center;">13000</td> <td style="text-align: center;">20000</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1997 - Funding reduced by Congress. Program restructured.<br/> FY 1999 - Funds are provided for the continuation of the ACTD program initiated in FY 1998.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 14384 | 18173 | 12998 | 0 | Appropriated Value | 14727 | 10000 |  |  | Adjustments to Appropriated Value | -1331 | -209 |  |  | FY 1998 Pres Bud Request | 13396 | 9791 | 13000 | 20000 |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |   |                    |       |       |  |  |                                   |       |      |  |  |                          |       |      |       |       |
| FY 1997 President's Budget  | 14384  | 18173                         | 12998          | 0              |                |                |                |                            |       |       |       |   |                    |       |       |  |  |                                   |       |      |  |  |                          |       |      |       |       |
| Appropriated Value  | 14727  | 10000                         |                |                |                |                |                |                            |       |       |       |   |                    |       |       |  |  |                                   |       |      |  |  |                          |       |      |       |       |
| Adjustments to Appropriated Value   | -1331  | -209                          |                |                |                |                |                |                            |       |       |       |   |                    |       |       |  |  |                                   |       |      |  |  |                          |       |      |       |       |
| FY 1998 Pres Bud Request  | 13396  | 9791                          | 13000          | 20000          |                |                |                |                            |       |       |       |   |                    |       |       |  |  |                                   |       |      |  |  |                          |       |      |       |       |
| Project D460  | Page 3 of 3 Pages  | Exhibit R-2 (PE 0603654A)     |                |                |                |                |                |                            |       |       |       |   |                    |       |       |  |  |                                   |       |      |  |  |                          |       |      |       |       |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                |                  |                  |   |                  |                  |                  | DATE<br>February 1997 |                  |            |
|---|----------------|------------------|------------------|---|------------------|------------------|------------------|-----------------------|------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                |                  |                  | PE NUMBER AND TITLE<br><b>0603710A Night Vision Advanced Technology</b> |                  |                  |                  |                       |                  |            |
| COST (In Thousands)   | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate  | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate      | Cost to Complete | Total Cost |
| Total Program Element (PE) Cost   | 31142          | 29761            | 19299            | 19250   | 37651            | 33487            | 33135            | 29516                 | Continuing       | Continuing |
| DK70 Night Vision Advanced Technology   | 14295          | 11186            | 4821             | 9652  | 14465            | 15669            | 14458            | 13639                 | Continuing       | Continuing |
| DK86 Night Vision, Airborne Systems   | 8919           | 5450             | 8336             | 9003  | 11782            | 7468             | 11091            | 8661                  | Continuing       | Continuing |
| DK87 Night Vision, Combat Vehicles  | 7928           | 10947            | 4861             | 0   | 11404            | 10350            | 7586             | 7216                  | Continuing       | Continuing |
| DC63 TRACTOR QUAKE  | 0              | 2178             | 1281             | 595   | 0                | 0                | 0                | 0                     | 0                | 4054       |
| <p><b>Mission Description and Budget Item Justification:</b> This program element (PE) develops new and improved tactical night vision and electronic sensor technologies for surveillance, target acquisition, pilotage driving, and to meet future requirements of infantry, anti-armor, air defense, combat vehicle, aircraft, and unmanned vehicle applications. This technology will provide the capability to acquire and engage hostile targets at extended ranges during day/night, smoke, obscured weather and battlefield conditions, significantly enhancing the warfighting capability and survivability of U.S. systems. Multisensor target acquisition suites will be demonstrated to provide rapid automatic acquisition of targets and battlefield intelligence data to allow U.S. forces to operate and react well within the operational timelines of threat forces. Multispectral and hyperspectral sensors will provide the capability to detect obscured, concealed, and reduced signature threats. Efforts are also directed toward technology for wide field-of-view (FOV) sensors to support dismounted soldier mobility and day/night nap-of-the-earth pilotage at high speeds. This PE will provide the target acquisition sensor technology options for advanced ground and airborne vehicle requirements, Rapid Force Projection Initiative (RFPI), and air defense platforms. Technology advances achieved under this PE have tri-service applications. Work in this program element is consistent with the resource-constrained Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and adheres to Tri-Service Reliance agreements on sensors and electronic devices with oversight and coordination provided by the Joint Directors of Laboratories. This work is related to and fully coordinated with efforts in PE 0602709A (Night Vision and Electro-Optics Technology), PE 0602270A (Electronic Warfare Technology), PE 0603774A (Night Vision Systems Advanced Development), and PE 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; Northrop-Grumman, Linthicum, MD; Lockheed-Martin Corp., Orlando, FL; Lockheed-Martin, Lexington, MA; Alliant, Hopkins, MN; EOIR, Spotsylvania, VA; Booze-Allen, McLean, VA; Omar McCall, Beltsville, MD. This project includes advanced technology demonstrations and tests of technologies to meet specific military needs and is therefore appropriately placed in Budget Activity 3.</p> |                |                  |                  |   |                  |                  |                  |                       |                  |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603710A Night Vision Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>DK70</b>       |                     |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| DK70 Night Vision Advanced Technology   | 14295             | 11186               | 4821                | 9652  | 14465               | 15669               | 14458                     | 13639                        | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project will develop and demonstrate high performance, sensor/multisensor technology to meet the target servicing requirement for weapon systems upgrades. Hunter Sensor Suite advanced technology demonstration (ATD) will demonstrate the feasibility of a lightweight, deployable and survivable hunter vehicle platform with an advanced, low observable, long range hunter sensor suite in the Rapid Force Projection Initiative advanced concept technology demonstration (RFPI ACTD). The Hunter Sensor Suite will combine second generation thermal imaging, day TV, eye safe laser rangefinder, embedded aided target recognition, and image compression/transfer technology. Remote Sentry ATD will demonstrate a compact, lightweight, integrated multisensor system capable of being implanted in forward areas and behind enemy lines to provide day/night, adverse weather, unmanned surveillance and targeting information in the Rapid Force Projection Initiative (RFPI) ACTD. Multi-function staring sensor technology demonstration will demonstrate a modular reconfigurable sensor suite that integrates multiple advanced sensor components including large format staring infrared arrays, multi-function laser and acoustic arrays. This technology demonstration will provide ground combat and amphibious assault vehicles with compact affordable sensor options for long range non-cooperative target recognition, mortar/sniper fire location and air defense against low signature UAV's and long range helicopters.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 14295 – Integrated the interim Hunter Sensor Suite (without aided target recognition ) on the hunter surrogate vehicle; delivered interim unit for Task Force XXI Army warfighting experiment (AWE)</li> <li>– Completed development of Hunter Sensor Suite aided target recognition system.</li> <li>– Fabricated “cheap suit” signature management appliqué and integrated “cheap suit” onto the hunter surrogate vehicle.</li> <li>– Completed integration and demonstrated Remote Sentry ATD hardware.</li> </ul> <p>Total 14295</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 10960 - Integrate aided target recognition (ATR) processor and automated command and control system with baseline Hunter Sensor Suite and vehicle; integrate with Remote Sentry, Rapid Force Projection Initiative (RFPI) command and control (C2) network, and RFPI weapons; conduct engineering tests to verify ATR and C2 performance; deliver sensor/vehicle system to RFPI ACTD.</li> <li>• 226 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 11186</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project DK70  |                   |                     | Page 2 of 7 Pages   |   |                     |                     | Exhibit R-2 (PE 0603710A) |                              |                     |            |

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|------|-------|--------------------|-------|-------|--|--|-----------------------------------|------|--|--|--|-------------------------|-------|-------|------|------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603710A Night Vision Advanced Technology</b> | <b>PROJECT</b><br><b>DK70</b> |                |                |                |                |                |                            |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |      |      |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4821 - Initiate component risk reduction for multifunction staring sensor demonstration, and develop reconfigurable sensor backplane that fully integrates aperture, power, and signal processing requirements for multiple platform applications.</li> </ul> <p>Total 4821</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 9652 - Complete design of multifunction sensor demonstration including large format, high speed mid-wave infrared (MWIR) staring array which may be capable of being reconfigured to be visible through either 5 micron or 8-12 micron operation.</li> </ul> <p>Total 9652</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">14624</td> <td style="text-align: center;">11425</td> <td style="text-align: center;">6321</td> <td style="text-align: center;">14110</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">15035</td> <td style="text-align: center;">11186</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-740</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">14295</td> <td style="text-align: center;">11186</td> <td style="text-align: center;">4821</td> <td style="text-align: center;">9652</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1998- Funding reprogrammed (-1500) to higher priority requirements.<br/>Funding: FY 1999- Funding reprogrammed (-4458) to higher priority requirements.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 14624 | 11425 | 6321 | 14110 | Appropriated Value | 15035 | 11186 |  |  | Adjustments to Appropriated Value | -740 |  |  |  | FY1998 Pres Bud Request | 14295 | 11186 | 4821 | 9652 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |      |      |
| FY 1997 President's Budget   | 14624  | 11425                         | 6321           | 14110          |                |                |                |                            |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |      |      |
| Appropriated Value   | 15035  | 11186                         |                |                |                |                |                |                            |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |      |      |
| Adjustments to Appropriated Value  | -740   |                               |                |                |                |                |                |                            |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |      |      |
| FY1998 Pres Bud Request  | 14295  | 11186                         | 4821           | 9652           |                |                |                |                            |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |      |      |
| Project DK70   | Page 3 of 7 Pages  | Exhibit R-2 (PE 0603710A)     |                |                |                |                |                |                            |       |       |      |       |                    |       |       |  |  |                                   |      |  |  |  |                         |       |       |      |      |

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603710A Night Vision Advanced Technology</b> | <b>PROJECT</b><br><b>DK86</b> |
|--|--|-------------------------------|

| COST <i>(In Thousands)</i>          | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate | Cost to<br>Complete | Total Cost |
|-------------------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|
| DK86 Night Vision, Airborne Systems | 8919              | 5450                | 8336                | 9003                | 11782               | 7468                | 11091               | 8661                | Continuing          | Continuing |

**A. Mission Description and Justification:** This project concentrates on the development and flight evaluation of night pilotage technology, imaging sensor and display technology, and automated obstacle warning technology to meet the requirements of future aviation platforms, and to enhance the operational capabilities and survivability of currently fielded attack, scout, cargo and utility helicopters. This technology will significantly enhance the survivability of Army aviation assets by permitting rotorcraft to fly at nap-of-the-earth (NOE) altitude and avoid obstacles in day/night/adverse weather conditions; and reduce exposure to air defense artillery, surveillance systems, and smart missiles. Technology includes high-performance multi-sensor pilotage technology and single-sensor advanced image intensification (AI2) technology for lower-cost applications. 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. 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-spectrum 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. The aerial scout sensor suite will provide non-line-of-sight targeting for weapons systems in the RFPI ACTD and provide options for airborne surveillance applications, including potential upgrades to the future tactical unmanned aerial vehicles (UAV). The air/land enhanced reconnaissance and targeting (ALERT) demonstration builds on the multisensor aided targeting (MSAT)-air program, which demonstrated an aided target recognition (ATR) capability for hovering helicopters. ALERT will demonstrate search on-the-move aided target acquisition using a FLIR/laser sensor suite for future aviation assets. Technology developed under this project is also directly applicable to the night flying requirements of the other services and Special Operations Command's rotary wing aircraft.

- FY 1996 Accomplishments:**
- 8919 - Developed and integrated a wide field of view (FOV) (40 x 80 deg) dual spectrum (FLIR and I2) pilotage sensor technology to provide significant reduction in pilot workload.
  - Conducted AI2 advanced warfighting demo with the user; provided transition option to program manager.
  - Designed and developed aerial scout sensor technology that will provide non-line of sight targeting, over-the-hill battlefield reconnaissance surveillance, and battlefield assessment. Candidate sensors included staring FLIR, MTI radar and wide area infrared (IR) lines scanner.
- Total 8919

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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603710A Night Vision Advanced Technology</b>  | <b>PROJECT</b><br><b>DK86</b> |                |                |
| <b>FY 1997 Planned Program:</b>  |   |                               |                |                |
| • 5343   | - Demonstrate wide-FOV night pilotage system-helmet mounted display system and dual spectrum (FLIR and I2) sensors in a single turret.<br>- Complete evaluation of candidate aerial scout sensors and begin integration on aerial platform.<br>- Initiate ALERT ATD to develop on-the-move aided target recognition using 2nd Gen FLIR and multimode laser.   |                               |                |                |
| • 107  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.   |                               |                |                |
| Total  | 5450  |                               |                |                |
| <b>FY 1998 Planned Program:</b>  |   |                               |                |                |
| • 8336   | - Demonstrate ultra-wide FOV (40° X 80°) night pilotage system (helmet mounted display system and dual spectrum (IR and I <sup>2</sup> ) sensors in a single turret) to provide a significant reduction in pilot cognitive and physical work load.<br>- Complete integration of aerial scout sensor aircraft, complete ATR modifications to ground station; conduct performance testing and deliver to the RFPI ACTD.<br>- Establish baseline airborne FLIR ATR performance for on-the-move target detection and recognition. |                               |                |                |
| Total  | 8336  |                               |                |                |
| <b>FY 1999 Planned Program:</b>  |   |                               |                |                |
| • 9003   | - Develop approach for common module tactical UAV sensor payload and initiate preliminary design of lightweight multispectral and IR sensors.<br>- Complete algorithm upgrades to the ALERT ATR and sensor suite and evaluate improvement over baseline on-the-move target detection and recognition.<br>- Initiate development of multimode laser to provide range data and target profile information to the ALERT ATR.   |                               |                |                |
| Total  | 9003  |                               |                |                |
| <b>B. Project Change Summary</b>   |   |                               |                |                |
|  | <u>FY 1996</u>  | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget   | 9128  | 7766                          | 13365          | 15327          |
| Appropriated Value   | 9383  | 5450                          |                |                |
| Adjustments to Appropriated Value  | -464  |                               |                |                |
| FY1998 Pres Bud Request  | 8919  | 5450                          | 8336           | 9003           |
| Change Summary Explanation: Funding: FY 1997- Congressional reduction for aerial scout sensors.<br>FY 1998- Funding reprogrammed (-5029) to higher priority requirements.<br>FY 1999- Funding reprogrammed (-6324) to higher priority requirements |   |                               |                |                |
| Project DK86   | Page 5 of 7 Pages   | Exhibit R-2 (PE 0603710A)     |                |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> | DATE<br><b>February 1997</b> |
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| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603710A Night Vision Advanced Technology</b> | <b>PROJECT</b><br><b>DK87</b> |
|--|--|-------------------------------|

| COST (In Thousands)                | FY 1996 Actual | FY 1997 Estimate | FY 1998 Estimate | FY 1999 Estimate | FY 2000 Estimate | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | Cost to Complete | Total Cost |
|------------------------------------|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------|
| DK87 Night Vision, Combat Vehicles | 7928           | 10947            | 4861             | 0                | 11404            | 10350            | 7586             | 7216             | Continuing       | Continuing |

**A. Mission Description and Justification:** This project demonstrates target acquisition sensor technology to meet the stringent target acquisition requirements of future combat vehicles. Target Acquisition ATD will demonstrate an extended range, multisensor target acquisition suite for future tank, cavalry, and scout vehicles. The target acquisition multisensor suite will consist of a second generation thermal imaging sight with automated wide area search and aided target recognition, a low cost millimeter wave (MMW) ground radar and a multifunction laser. Electronic integrated sensor suite for air defense will demonstrate technology for the maneuver force with passive, automated volume search, target detection, tracking and identification, and low probability of intercept laser ranging of fixed wing, rotary, and cruise missile aircraft. Multi-function staring sensor technology demonstration will demonstrate a modular reconfigurable sensor suite that integrates multiple advanced sensor components including large format staring infrared arrays, multi-function laser and acoustic arrays.

**FY 1996 Accomplishments:**

- 7928 – Integrated the target acquisition ATD processor and sensor suite. Demonstrated and baselined the target acquisition sensor suite for performance.
  - Demonstrated millimeter wave (MMW) ground radar and multi-wavelength multi-function laser.
  - Completed electronic integrated sensor suite (EISS) data collection and algorithm enhancements, and single band/single aperture trade studies.
- Total 7928

**FY 1997 Planned Program:**

- 10715 – Demonstrate target acquisition multifunction laser and automatic target cueing as a potential upgrade to the M1A2, and demonstrate MTI radar to provide long-range, adverse-weather target cueing.
  - Provide field demonstration support and test data analysis in support of Phase I RFPI acoustic test program.
  - Complete static demonstrations of alternative passive sensor (acoustic and infrared search and track) technologies to support forward areas air defense system upgrades.
- 232 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
- Total 10947

**FY 1998 Planned Program:**

- 3361 – Modify M1A2 commander’s independent thermal viewer with multifunction laser and gimbal scan; integrate with MMW radar and demonstrate multisensor ATR for the Future Main Battle Tank.
  - Provide field demonstration support and test data analysis in support of Phase II RFPI acoustic test program.

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|-------|------|------|--------------------|------|-------|--|--|-----------------------------------|-------|--|--|--|-------------------------|------|-------|------|---|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603710A Night Vision Advanced Technology</b> | <b>PROJECT</b><br><b>DK87</b> |                |                |                |                |                |                            |      |       |      |      |                    |      |       |  |  |                                   |       |  |  |  |                         |      |       |      |   |
| <p><b>FY 1998 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Conduct limited, on-the-move testing of alternative passive sensor (acoustic and infrared search and track) technologies to support forward area air defense system upgrades.</li> <li>• 1500 - Define interfaces and size/weight/power constraints to allow future integration of multifunction sensor suite with a combat vehicle testbed.</li> </ul> <p>Total 4861</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99.</p> <p><b>B. Project Change Summary</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9130</td> <td style="text-align: center;">11182</td> <td style="text-align: center;">4855</td> <td style="text-align: center;">6548</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">9385</td> <td style="text-align: center;">10947</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-1457</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">7928</td> <td style="text-align: center;">10947</td> <td style="text-align: center;">4861</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996- Funding reprogrammed (-1457) to higher priority requirements.<br/>FY 1999- Funding reprogrammed (-6548) to higher priority requirements.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9130 | 11182 | 4855 | 6548 | Appropriated Value | 9385 | 10947 |  |  | Adjustments to Appropriated Value | -1457 |  |  |  | FY1998 Pres Bud Request | 7928 | 10947 | 4861 | 0 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |       |      |      |                    |      |       |  |  |                                   |       |  |  |  |                         |      |       |      |   |
| FY 1997 President's Budget   | 9130   | 11182                         | 4855           | 6548           |                |                |                |                            |      |       |      |      |                    |      |       |  |  |                                   |       |  |  |  |                         |      |       |      |   |
| Appropriated Value   | 9385   | 10947                         |                |                |                |                |                |                            |      |       |      |      |                    |      |       |  |  |                                   |       |  |  |  |                         |      |       |      |   |
| Adjustments to Appropriated Value  | -1457  |                               |                |                |                |                |                |                            |      |       |      |      |                    |      |       |  |  |                                   |       |  |  |  |                         |      |       |      |   |
| FY1998 Pres Bud Request  | 7928   | 10947                         | 4861           | 0              |                |                |                |                            |      |       |      |      |                    |      |       |  |  |                                   |       |  |  |  |                         |      |       |      |   |
| Project DK87   | Page 7 of 7 Pages  | Exhibit R-2 (PE 0603710A)     |                |                |                |                |                |                            |      |       |      |      |                    |      |       |  |  |                                   |       |  |  |  |                         |      |       |      |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603734A Military Engineering Advanced Technology</b> |                     |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost  | 14544             | 20213               | 12231               | 17334  | 16431               | 5444                | 4962                | 3775                         | Continuing          | Continuing |
| DT08 Combat Engineering Systems  | 2330              | 1426                | 1663                | 2988   | 3904                | 5444                | 4962                | 3775                         | Continuing          | Continuing |
| DT10 Total Distribution Advanced Technology Demonstration  | 12214             | 9384                | 0                   | 0  | 0                   | 0                   | 0                   | 0                            | 0                   | 21598      |
| DT12 Rapid Terrain Visualization   | 0                 | 9403                | 10568               | 14346  | 12527               | 0                   | 0                   | 0                            | 0                   | 46844      |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> This program encompasses demonstrations of technologies that provide the capabilities required for the engineer and logistician to successfully plan, rehearse and execute missions in support of the commander and the force projection Army. Critical deficiencies exist in the Army's ability to rapidly acquire, update, maintain and distribute terrain data in support of both terrain and battlefield visualization; to apply physics-based reasoning to planning and executing mobility, counter-mobility, survivability, and general engineering missions; to conduct logistics-over-the-shore operations in adverse sea states; to establish in-transit visibility of materiel and supplies; and to manage logistics distribution and logistics automation. The demonstration projects in this program element focus on the technologies required to correct these critical deficiencies. Capabilities demonstrated will be applicable to missions at all echelons within the force structure during either combat operations or operations other than war. Demonstrations are integral components of Army Advanced Warfighting Experiments, Advanced Concept Technology Demonstrations, other Advanced Technology Demonstrations, and joint field training exercises. Emphasis is placed on rapid transition of technologies into Command and Control (C2) systems, combat/war models and simulations or simulators. This provides shared situational awareness, common representation of terrain and consistent predictions or assessments of mobility, counter-mobility, survivability, and logistics missions in the linkage of C2 systems, models, and simulations being developed by the Army to exploit information technologies. The work in this program element is consistent with the Army Science and Technology Master Plan, the Training and Doctrine Command (TRADOC) Battlefield Visualization Concept, the Office of the Deputy Chief of Staff, Operations (ODCSOPS) Battlefield Visualization Objectives, the Army Modernization Plan, and Project Reliance. This program is dedicated to conducting field demonstrations and tests of technologies to meet specific military needs and is properly placed in Budget Activity 3.</p> |                   |                     |                     |  |                     |                     |                     |                              |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603734A Military Engineering Advanced Technology</b> |                     |                     |                           | PROJECT<br><b>DT08</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| DT08 Combat Engineering Systems   | 2330              | 1426                | 1663                | 2988  | 3904                | 5444                | 4962                      | 3775                         | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project will demonstrate decision support applications for mobility, countermobility and survivability that support multiple battlefield operating systems, including maneuver, command and control, and mobility and survivability. An integrated obstacle planning and simplified survivability assessment system will be demonstrated in brigade and division level exercises. This software suite will enable the engineer to rapidly generate engineer assessments, conduct course of action analyses, provide engineer force level information to commanders and other staff/functional elements, and provide the engineer with the ability to effectively execute command and control of the complex battlefield missions of countermobility and survivability. This project will also demonstrate at full scale a capability to conduct logistics-over-the-shore (LOTS) operations at sea state 3; this will greatly increase LOTS throughput of equipment and supplies from ship to shore, and significantly reduce the time and materials required to establish linkages between LOTS sites and the inland transportation infrastructure. Present LOTS operations are limited to sea state 2 or less; this is an unacceptable limitation to force projection. A complete engineering design of a full-scale Rapidly Installed Breakwater System (RIBS) will be developed based on detailed engineering analyses, laboratory, and 1/4-scale field tests. A full-scale demonstration of RIBS that reduces waves conditions from the lower range of sea state 4 by 50 percent will be performed. Evaluations of the full-scale deployability, transportability, mooring loads, structural integrity, and potential of RIBS for storm survival will be conducted. The capability to rapidly and, with minimum logistics burdens and reduced engineer equipment, stabilize beach sands and soft soils for roads, material storage areas, heliports, and other horizontal operating surfaces associated with LOTS operations will be demonstrated. Transition targets for the software capabilities that will be integrated and demonstrated under this project include the Army Battle Command System (ABCS) and the Digital Topographic Support System (DTSS). The work is performed by the Cold Regions Research and Engineering Laboratory, Hanover, NH, and the Waterways Experiment Station, Vicksburg, MS.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 2005 - Demonstrated integrated database generation and update capabilities in support of early entry forces.<br/>- Developed and demonstrated version 1.0 of mobility and survivability software suite at Prairie Warrior 96.</li> <li>• 325 - Integrated, demonstrated, and transitioned task force level decision support applications for countermobility and survivability to the Fort Hood experimental force.</li> </ul> <p>Total 2330</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project DT08  |                   |                     | Page 2 of 8 Pages   |   |                     |                     | Exhibit R-2 (PE 0603734A) |                              |                     |            |



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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |  | DATE<br><b>February 1997</b>  |                |                |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  | <b>PE NUMBER AND TITLE</b><br><b>0603734A Military Engineering Advanced Technology</b>   | <b>PROJECT</b><br><b>DT08</b> |                |                |
| <b>FY 1997 Planned Program:</b>   |  |                               |                |                |
| • 1391  | - Upgrade mobility and survivability software to version 1.5 through inclusion of wide area munition effectiveness, military hydrology, and excavation in frozen soils algorithms, and initiate implementation of automated obstacle planning.<br>- Demonstrate mobility and survivability version 1.5 at Prairie Warrior 97.  |                               |                |                |
| • 35  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                               |                |                |
| Total   | 1426   |                               |                |                |
| <b>FY 1998 Planned Program:</b>   |  |                               |                |                |
| • 1663  | - Provide final verification and integrate algorithms into mobility and survivability battlefield operating system software.<br>- Demonstrate mobility and survivability battlefield operating system software during Ulchi Focus Lens in Korea to verify world-wide planning capabilities.<br>- Conduct demonstrations to validate engineer resource allocation algorithms during Division XXI exercise.  |                               |                |                |
| Total   | 1663   |                               |                |                |
| <b>FY 1999 Planned Program:</b>   |  |                               |                |                |
| • 2988  | - Establish and verify structural requirements for sea-worthiness of full-scale Rapidly Installed Breakwater System to attenuate adverse sea-states for logistics-over-the-shore operations.<br>- Determine and validate sea-state 3 mooring requirements for Rapidly Installed Breakwater System (RIBS); finalize design of full-scale RIBS.<br>- Acquisition of geotechnical materials, site selection, and site preparation for FY 2000 demonstration of beach sand stabilization technologies. |                               |                |                |
| Total   | 2988   |                               |                |                |
| <b>B. Project Change Summary</b>  |  |                               |                |                |
|   | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |
| FY 1997 President's Budget  | 2834   | 1456                          | 1654           | 482            |
| Appropriated Value  | 2913   | 1426                          |                |                |
| Adjustments to Appropriated Value   | -583   |                               |                |                |
| FY 1998 Pres Bud Request  | 2330   | 1426                          | 1663           | 2988           |
| Change Summary Explanation: Funding: FY 1996 - funds reprogrammed (-433) to higher priority requirements; undistributed Congressional reductions and rescissions (-71).<br>FY 1999 - Project increased (+2506) for LOTS Advanced Technology Demonstration . |  |                               |                |                |
| Project DT08  | Page 3 of 8 Pages  | Exhibit R-2 (PE 0603734A)     |                |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                        |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603734A Military Engineering Advanced Technology</b> |                     |                     |                           |                              | PROJECT<br><b>DT10</b> |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete    | Total Cost |
| DT10 Total Distribution Advanced Technology Demonstration   | 12214             | 9384                | 0                   | 0   | 0                   | 0                   | 0                         | 0                            | 0                      | 21598      |
| <p><b>A. <u>Mission Description and Justification:</u></b> Operation Desert Storm showed that the logistics distribution system needed major improvements to increase its efficiency and effectiveness. The Total Distribution Advanced Technology Demonstration (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 supply capability. These tools will be demonstrated within the context of an integrated suite of logistics data management tools, decision support tools, and collaborative planning tools. The work is being performed by: the Communications Electronics Research Development and Engineering Center, Ft. Monmouth, NJ; the Army Research Laboratory, Aberdeen Proving Ground, MD; the Waterways Experimentation Station, Vicksburg, MS; and the Topographic Engineering Center, Alexandria, VA.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 5095 - Developed expanded Logistics Anchor Desk (LAD) connectivity to real logistics data sources i.e. the Standard Army Management Information Systems (STAMIS) and additional classes of supply.             <ul style="list-style-type: none"> <li>- Developed and integrated enhanced infrastructure and terrain visualization capabilities and data such as engineer data and road/port data.</li> <li>- Developed a simulation capability for additional Cost and Operational Analysis (COA) to include machine learning and knowledge discovery and expanded data visualization in the LAD.</li> </ul> </li> <li>• 3882 - Developed interfaces into the Combat Service Support Control System/Army Global Command and Control System (CSSCS/AGCCS) architecture in a client-server based relationship while providing technology options for these systems.             <ul style="list-style-type: none"> <li>- Developed links and provided the warfighting commanders with enhanced leave-behind logistics automation capabilities through participation in Advanced Warfighting Experiments (AWEs) such as Prairie Warrior and Unified Endeavor.</li> </ul> </li> <li>• 3237 - HQ AMC support to Joint Logistics Advanced Concept Technology Demonstration (ACTD).</li> </ul> <p>Total 12214</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4680 - Complete development of expanded LAD connectivity to real logistics data sources by incorporating automated data management and other data integrity utilities.             <ul style="list-style-type: none"> <li>- Develop enhanced LAD COA and logistics automation and infrastructure assessment capabilities using sensitivity analysis and total COA analysis.</li> </ul> </li> <li>• 4475 - Transition advanced LAD capabilities into the CSSCS/AGCCS architecture to provide these systems improved logistics capabilities.</li> </ul> |                   |                     |                     |   |                     |                     |                           |                              |                        |            |
| Project DT10  |                   |                     | Page 4 of 8 Pages   |   |                     |                     | Exhibit R-2 (PE 0603734A) |                              |                        |            |

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|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|------|------|---|---|--------------------|------|------|--|--|-----------------------------------|-------|--|--|--|--------------------------|-------|------|---|---|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603734A Military Engineering Advanced Technology</b> | <b>PROJECT</b><br><b>DT10</b> |                |                |                |                |                |                            |      |      |   |   |                    |      |      |  |  |                                   |       |  |  |  |                          |       |      |   |   |
| <p><b>FY 1997 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Insert enhanced LAD COA technology into leave-behind logistics automation capabilities that are fully integrated into the AGCCS and the Global Command and Control Systems (GCCS) for the warfighting CINCs.</li> <li>- Demonstrate LAD capabilities integrated within the common architecture in Prairie Warrior and Task Force XXI.</li> <li>- Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total            229            9384</p> <p><b>FY 1998 Planned Program:</b> Project not funded in FY 98</p> <p><b>FY 1999 Planned Program:</b> Project not funded in FY 99</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="width: 10%; text-align: center;"><u>FY 1996</u></th> <th style="width: 10%; text-align: center;"><u>FY 1997</u></th> <th style="width: 10%; text-align: center;"><u>FY 1998</u></th> <th style="width: 10%; text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">9207</td> <td style="text-align: center;">9585</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">9467</td> <td style="text-align: center;">9384</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">+2747</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY 1998 Pres Bud Request</td> <td style="text-align: center;">12214</td> <td style="text-align: center;">9384</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> <p>Change Summary Explanation: Funding: FY 1996 - funds reprogrammed into this project for Joint Logistics ACTD.</p> |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President's Budget | 9207 | 9585 | 0 | 0 | Appropriated Value | 9467 | 9384 |  |  | Adjustments to Appropriated Value | +2747 |  |  |  | FY 1998 Pres Bud Request | 12214 | 9384 | 0 | 0 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |      |      |   |   |                    |      |      |  |  |                                   |       |  |  |  |                          |       |      |   |   |
| FY 1997 President's Budget   | 9207   | 9585                          | 0              | 0              |                |                |                |                            |      |      |   |   |                    |      |      |  |  |                                   |       |  |  |  |                          |       |      |   |   |
| Appropriated Value   | 9467   | 9384                          |                |                |                |                |                |                            |      |      |   |   |                    |      |      |  |  |                                   |       |  |  |  |                          |       |      |   |   |
| Adjustments to Appropriated Value  | +2747  |                               |                |                |                |                |                |                            |      |      |   |   |                    |      |      |  |  |                                   |       |  |  |  |                          |       |      |   |   |
| FY 1998 Pres Bud Request   | 12214  | 9384                          | 0              | 0              |                |                |                |                            |      |      |   |   |                    |      |      |  |  |                                   |       |  |  |  |                          |       |      |   |   |
| Project DT10   | Page 5 of 8 Pages  | Exhibit R-2 (PE 0603734A)     |                |                |                |                |                |                            |      |      |   |   |                    |      |      |  |  |                                   |       |  |  |  |                          |       |      |   |   |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                           | DATE<br><b>February 1997</b>  |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603734A Military Engineering Advanced Technology</b> |                     |                     |                           | <b>PROJECT</b><br><b>DT12</b> |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate           | Cost to<br>Complete | Total Cost |
| DT12 Rapid Terrain Visualization  | 0                 | 9403                | 10568               | 14346  | 12527               | 0                   | 0                         | 0                             | 0                   | 46844      |
| <p><b>A. <u>Mission Description and Justification:</u></b> This project will demonstrate the integration of critical battlefield visualization technologies in support of crisis response and force projection missions to enable the Joint Warfighter to successfully plan, rehearse and execute his mission. Digital Topographic Data (DTD) are the foundation for battlefield visualization and these data are not currently available for most areas where Force XXI units will operate. Methods for rapidly producing DTD to support military operations, particularly early entry, and the optimum resolution and format of digital terrain data for both current and notional systems need to be established. The Rapid Terrain Visualization (RTV) (formerly Rapid Battlefield Visualization) Advanced Concept Technology Demonstration (ACTD) will be conducted to demonstrate capabilities to rapidly collect source data and generate high resolution digital terrain databases to support crisis response and force projection operations within the timelines required by the joint force commander. The RTV ACTD will also demonstrate capabilities for the commander to integrate these terrain databases with current situation data, and manipulate and display the integrated databases to determine how to achieve his objectives, and visualize the desired end state. A capability for rapid collection of high resolution (up to 1-meter grid spacing) digital terrain elevation data will be demonstrated, and imagery from aircraft and satellite platforms will be used to generate terrain feature data and map backgrounds. The RTV ACTD will provide and leave behind computer workstations and applications software to generate high resolution terrain databases, to evaluate courses of action using mission planning and embedded wargaming software, and to support mission rehearsals. This ACTD will also provide a tool for further exploration of emerging warfighting concepts and doctrine. The ACTD will leverage the Defense Advanced Research Projects Agency (DARPA) Battlefield Awareness and Data Dissemination ACTD for data dissemination over the global broadcast system and tactical communications, and the Communications and Electronics Command (CECOM) Battlespace Command and Control (BC2) Advanced Technology Demonstration for workstations and applications software. This project is cooperatively executed with and will leverage work in progress by: the Topographic Engineering Center (TEC); National Imagery and Mapping Agency (NIMA); National Reconnaissance Office (NRO); Defense Airborne Reconnaissance Office (DARO); and the Defense Modeling and Simulation Office (DMSO). This project is managed by the Joint Precision Strike Demonstration (JPSD) Office, Program Executive Officer, Intelligence and Electronic Warfare (PEO-IEW), Ft. Belvoir, VA. Contractors include: Raytheon, Bedford, MA; SAIC, Rosslyn, VA; MRJ, Oakton, VA; TASC, McLean, VA; EO-IR Measurements, Spottsylvania, VA; Space Applications Corp, Vienna, VA; and MTC, Shrewsbury, NJ. Participating government laboratories include: Topographic Engineering Center, Alexandria, VA; Army Research Laboratory, Adelphi, MD; Communications and Electronics Research, Development and Engineering Center, Ft. Monmouth, NJ.</p> <p><b>FY 1996 Accomplishments:</b> Program not funded. Initial planning for the Rapid Terrain Visualization (RTV) ACTD was completed under PE 0603238A (Air Defense/Precision Strike Technology)/ Project D177.</p> |                   |                     |                     |  |                     |                     |                           |                               |                     |            |
| Project DT12  |                   |                     | Page 6 of 8 Pages   |  |                     |                     | Exhibit R-2 (PE 0603734A) |                               |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b> |  | DATE<br><b>February 1997</b> |
|--|--|------------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE  | PROJECT                      |
| <b>3 - Advanced Technology Development</b>                     | <b>0603734A Military Engineering Advanced Technology</b>   | <b>DT12</b>                  |
| <b>FY 1997 Planned Program:</b>                                |  |                              |
| • 5653   | - Establish contract with industry to integrate technologies needed to configure a system to acquire and process high resolution digital terrain elevation data within tactically significant timelines.<br>- Generate feature data of XVIII Airborne Corps (ABC) Area Of Interest (AOI) using advanced, semi-automated terrain feature extraction software and create tailored databases for visualization workstations.<br>- Integrate C4I systems (e.g., the All Source Analysis System and the Maneuver Control System) with visualization systems to enable common representation of friendly and threat force location and strength. |                              |
| • 3530   | - Demonstrate rapid battlefield visualization capability in JPSD Integration and Evaluation Center (IEC) and measure effectiveness of various RTV system configurations.<br>- Evaluate military utility of RTV technologies and develop concepts of operations during XVIII ABC Advanced Warfighting Experiments (AWEs).   |                              |
| 220  | - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                              |
| Total  | 9403   |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 5056   | - Conduct proof-of-concept data collection of high resolution digital elevation data sets to support the XVIII ABC AWE .<br>- Merge multi-resolution elevation and feature data into a fully integrated data set using prototype battlefield visualization database generation systems and generate tailored databases for visualization workstations.   |                              |
| • 5512   | - Develop capability to integrate live feeds from intelligent sensor systems into RTV mission planning workstation in near-real-time.<br>- Demonstrate integrated RTV systems in JPSD IEC and obtain data to evaluate measures of effectiveness.<br>- Participate in the XVIII ABC AWEs and TF-XXI Division AWE.   |                              |
| Total  | 10568  |                              |
| <b>FY1999 Planned Program:</b>                                 |  |                              |
| • 6155   | - Acquire and process high resolution digital elevation data set in direct support of an XVIII ABC AWE.<br>- Exploit multi-spectral and hyperspectral imagery to accelerate the terrain feature extraction process using the prototype RTV database generation system.   |                              |
| • 8191   | - Extend RTV capability from Corps level to selected XVIII Airborne Corps Division elements.<br>- Demonstrate end-to-end RTV process in the IEC including results of rapid data collection and live feeds to XVIII Airborne Corps.<br>- Initiate upgrade of workstations and software at XVIII Airborne Corps to objective configuration and use in AWEs.  |                              |
| Total  | 14346  |                              |
| Project DT12   | Page 7 of 8 Pages  | Exhibit R-2 (PE 0603734A)    |

| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)      |                |                | DATE                 |                |
|--|----------------|----------------|----------------------|----------------|
| BUDGET ACTIVITY  |                |                | PROJECT              |                |
| <b>3 - Advanced Technology Development</b>               |                |                | <b>February 1997</b> |                |
| PE NUMBER AND TITLE                                      |                |                | PROJECT              |                |
| <b>0603734A Military Engineering Advanced Technology</b> |                |                | <b>DT12</b>          |                |
| <b><u>B. Project Change Summary</u></b>                  | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u>       | <u>FY 1999</u> |
| FY 1997 President's Budget                               | 0              | 9623           | 10591                | 14392          |
| Appropriated Value                                       |                | 9403           |                      |                |
| Adjustments to Appropriated Value                        |                |                |                      |                |
| FY 1998 Pres Bud Request                                 | 0              | 9403           | 10568                | 14346          |
| Project DT12   |                |                |                      |                |
| Page 8 of 8 Pages  |                |                |                      |                |
| Exhibit R-2 (PE 0603734A)                                |                |                |                      |                |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |  |                     |                     |                     | DATE<br><b>February 1997</b> |                     |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>  |                   |                     |                     | <b>PE NUMBER AND TITLE</b><br><b>0603772A Advanced Tactical Computer Science<br/>and Sensor Technology</b> |                     |                     |                     |                              |                     |            |
| <i>COST (In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| Total Program Element (PE) Cost   | 27185             | 21282               | 19970               | 23079  | 23810               | 21573               | 22453               | 23578                        | Continuing          | Continuing |
| D101 Tactical Automation  | 17436             | 13430               | 12745               | 17317  | 17124               | 15418               | 15729               | 16566                        | Continuing          | Continuing |
| D243 Sensors and Signal Processing  | 3125              | 955                 | 3863                | 5762   | 6686                | 6155                | 6724                | 7012                         | Continuing          | Continuing |
| D281 Ground Combat Identification Demonstrations  | 6624              | 6897                | 3362                | 0  | 0                   | 0                   | 0                   | 0                            | 0                   | 25865      |
| <p><b><u>Mission Description and Budget Item Justification:</u></b> This program element supports projects that provide advanced computer science and technology solutions to command and control (C2), data correlation, tactical surveillance, and combat identification problems. Specifically, this program addresses solutions to integration of the battlefield, synchronization of combined arms forces, synchronization of joint forces, C2 on the move, correlation of intelligence data from airborne and space based sensors, integrated situation awareness (SA), battlefield combat identification (CI), point of engagement identification (ID) approaches to reduce fratricide for ground forces, unmanned air vehicle surveillance, and hostile weapons location. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. It is related to and fully coordinated with efforts in PE 0602783A (Computer and Software Technology), PE 0602782A (Command, Control and Communications Technology), PE 0603006A (Command, Control and Communications Advanced Technology), PE 0602709A (Night Vision Technology), PE 0603710A (Night Vision Advanced Technology), and PE 0602120A (Electronic Surveillance and Fuzing Technology ) in accordance with the ongoing Reliance joint planning process. 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.</p> |                   |                     |                     |  |                     |                     |                     |                              |                     |            |

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|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------------|---------------------|------------|
| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |                   |                     |                     |   |                     |                     |                           | DATE<br><b>February 1997</b> |                     |            |
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603772A Advanced Tactical Computer Science<br/>and Sensor Technology</b> |                     |                     |                           | PROJECT<br><b>D101</b>       |                     |            |
| COST <i>(In Thousands)</i>  | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete | Total Cost |
| D101 Tactical Automation  | 17436             | 13430               | 12745               | 17317   | 17124               | 15418               | 15729                     | 16566                        | Continuing          | Continuing |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 solutions of Army-unique command and control deficiencies in the area of combined arms operations. Specifically, this project addresses solutions for 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. 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 battlespace command and control (BC2) advanced technology demonstration (ATD) will take technologies for common view of the battlefield from the combined arms command and control (CAC2) ATD and other sources to develop prototype software capabilities and architectures supporting the Army digital battlestaff requirements for merging situation awareness and battle command with mission planning/rehearsal and battlefield visualization capabilities. Tri-service interoperability and supporting information architecture will also be determined. Joint developer/user warfighting demonstrations will be conducted in conjunction with the Mounted, Dismounted, and Battle Command Battle Labs. Products will be transitioned to Program Executive Offices (PEOs) (Command, Control and Communications Systems (C3S), Aviation, etc.) for integration within their systems and subsequent fielding. The Rapid Force Projection Initiative (RFPI) technologies will provide command, control and communications (C3) hardware and software products that integrate RFPI hunter-standoff killer and C3 technologies and systems in a manner that supports integration with Force XXI Battlefield Operating Systems and Army Tactical Command and Control System (ATCCS) components.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 15686 – Completed joint combined arms command and control (CAC2) demonstration in conjunction with the Mounted Battlespace Battle Lab and demonstrated components of a brigade digital force.</li> <li>• 1750 – Began 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.             <ul style="list-style-type: none"> <li>– Continued development and evaluation of RFPI C2 architecture and software.</li> <li>– Performed RFPI digital integrated laboratory (DIL) testing to verify system performance.</li> <li>– Designed prototype RFPI light tactical operations center (TOC) and fabricated three systems.</li> </ul> </li> </ul> <p>Total 17436</p> |                   |                     |                     |   |                     |                     |                           |                              |                     |            |
| Project D101  |                   |                     | Page 2 of 8 Pages   |   |                     |                     | Exhibit R-2 (PE 0603772A) |                              |                     |            |



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|--|--|------------------------------|
| BUDGET ACTIVITY  | PE NUMBER AND TITLE  | PROJECT                      |
| <b>3 - Advanced Technology Development</b>                     | <b>0603772A Advanced Tactical Computer Science and Sensor Technology</b>   | <b>D101</b>                  |
| <b>FY 1997 Planned Program:</b>                                |  |                              |
| • 9369   | – BC2 ATD: Develop battlefield visualization prototype to provide software tools supporting: consistent battlespace understanding; forecasting, planning, and resource allocation; integrated force management.  |                              |
|  | – Demonstrate initial commander and battle staff work station at Task Force XXI advanced warfighting experiment (AWE).   |                              |
|  | – Evaluate the requirements for division, brigade and battalion command, control, computers and intelligence (C4I) architecture which is interoperable with corps, joint and allied assets.  |                              |
| • 3752   | – Complete prototype RFPI light digital TOC (LDTOC) and LDTOC simulator integration and fabrication.   |                              |
|  | – Perform RFPI LDTOC DIL inter-operability testing.  |                              |
|  | – Develop RFPI LDTOC distributed command and control (DC2) and communication software.   |                              |
|  | – Integrate hardware and software for LDTOC and LDTOC simulator.   |                              |
|  | – Deliver hardware for RFPI Advanced Concept Technology Demonstration (ACTD) (LDTOC and LDTOC simulator).  |                              |
| • 309  | – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.  |                              |
| Total  | 13430  |                              |
| <b>FY 1998 Planned Program:</b>                                |  |                              |
| • 10630  | – BC2 ATD: Demonstrate a composite digital terrain/enemy/friendly visualization display with embedded, linked combat information and conduct collaborative planning across the battlespace. This includes integrated situation awareness, collaborative replanning and rehearsal and decision support. |                              |
|  | – Conduct analysis of tactical Internet and wideband communications systems performance to permit improvements in C4I warfighting capability encompassing transmission of data, imagery, and tactical video teleconferencing.  |                              |
|  | – Evaluate the battlefield visualization (BV)/C2 prototype capabilities through participation in AWE/battle lab warfighting experiment (BLWE) as well as participation/integration in experiments and demonstrations with the rapid battlefield visualization (RBV) ACTD.                              |                              |
| • 2115   | – Complete light digital TOC (LDTOC) communications processor.   |                              |
|  | – Complete LDTOC C2 software.  |                              |
|  | – Perform LDTOC modifications.   |                              |
|  | – Support modeling and simulation analysis for the advanced concepts to be employed during the RFPI ACTD.  |                              |
| Total  | 12745  |                              |
| Project D101   | <i>Page 3 of 8 Pages</i>   | Exhibit R-2 (PE 0603772A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |  | DATE<br><b>February 1997</b>  |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
|--|--|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|-------|-------|-------|-------|--------------------|-------|-------|--|--|-----------------------------------|-------|--|--|--|-------------------------|-------|-------|-------|-------|
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   | <b>PE NUMBER AND TITLE</b><br><b>0603772A Advanced Tactical Computer Science<br/>and Sensor Technology</b> | <b>PROJECT</b><br><b>D101</b> |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
| <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 12973 – BC2 ATD: Demonstrate prototype C2 decision aids using advanced concepts in tactical assessment and forecasting. Also include interactive modeling and simulation (wargaming) and course of action analysis supporting mission planning/rehearsal/execution.             <ul style="list-style-type: none"> <li>– Systems architecture efforts will focus on multi-echelon Joint/Allied assets providing faster/more accurate/more intuitive/tailored information.</li> <li>– Transition validated technology solutions/capabilities to applicable PEOs.</li> </ul> </li> <li>• 4344 – Provide the capability to accomplish commander’s command and control mission/functions while on-the-move.             <ul style="list-style-type: none"> <li>– Assess the ability of computer-aided decision support for the reduction of staff workload.</li> <li>– Provide a test bed for the command, staff and developer communities to integrate diverse concepts into C2 platforms.</li> <li>– Provide a live to virtual capability to support C2 experimentation in AWEs/BLWEs..</li> </ul> </li> </ul> <p>Total            17317</p> |  |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
| <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%;"></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>FY 1997 President’s Budget</td> <td style="text-align: center;">17871</td> <td style="text-align: center;">13988</td> <td style="text-align: center;">12775</td> <td style="text-align: center;">17375</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">18686</td> <td style="text-align: center;">13430</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-1250</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">17436</td> <td style="text-align: center;">13430</td> <td style="text-align: center;">12745</td> <td style="text-align: center;">17317</td> </tr> </tbody> </table>  |  |                               |                | <u>FY 1996</u> | <u>FY 1997</u> | <u>FY 1998</u> | <u>FY 1999</u> | FY 1997 President’s Budget | 17871 | 13988 | 12775 | 17375 | Appropriated Value | 18686 | 13430 |  |  | Adjustments to Appropriated Value | -1250 |  |  |  | FY1998 Pres Bud Request | 17436 | 13430 | 12745 | 17317 |
|  | <u>FY 1996</u>   | <u>FY 1997</u>                | <u>FY 1998</u> | <u>FY 1999</u> |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
| FY 1997 President’s Budget   | 17871  | 13988                         | 12775          | 17375          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
| Appropriated Value   | 18686  | 13430                         |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
| Adjustments to Appropriated Value  | -1250  |                               |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
| FY1998 Pres Bud Request  | 17436  | 13430                         | 12745          | 17317          |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |
| Project D101   | <i>Page 4 of 8 Pages</i>   | Exhibit R-2 (PE 0603772A)     |                |                |                |                |                |                            |       |       |       |       |                    |       |       |  |  |                                   |       |  |  |  |                         |       |       |       |       |

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| RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)   |                   |                     |                     |   |                     |                     |                           | DATE<br>February 1997  |                     |            |
|---|-------------------|---------------------|---------------------|---|---------------------|---------------------|---------------------------|------------------------|---------------------|------------|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   |                   |                     |                     | PE NUMBER AND TITLE<br><b>0603772A Advanced Tactical Computer Science<br/>and Sensor Technology</b> |                     |                     |                           | PROJECT<br><b>D243</b> |                     |            |
| COST (In Thousands)   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate | FY 1999<br>Estimate   | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate    | Cost to<br>Complete | Total Cost |
| D243 Sensors and Signal Processing  | 3125              | 955                 | 3863                | 5762  | 6686                | 6155                | 6724                      | 7012                   | Continuing          | Continuing |
| <p><b>A. Mission Description and Justification:</b> This project provides for advanced development of new radar and signal processing concepts for bistatic radar, low cost tactical aerial vehicle radars, and ultra-wideband foliage penetrating radar. The bistatic radar for weapons location (BRWL) technology demonstration provides advanced transmitter and signal processing technology for improved real-time, all-weather, automatic detection, classification and identification of artillery, mortar, cruise missile and aircraft targets, while significantly enhancing survivability of the radar system. The low cost airborne moving target indicator ( MTI) radar will provide wide area surveillance capability in a modular package adaptable to multiple tactical aerial vehicle applications, including unmanned aerial vehicle (UAV) platforms. A new generation of ultra-wideband radars will provide foliage and ground penetrating technology for aerial surveillance and targeting, and enhance minefield and bunker detection capabilities.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3125 – Completed demonstrations of BRWL in advanced warfighting experiments with Depth and Simultaneous Attack Battle Laboratory and provided technology option to the Firefinder pre-planned product improvement (P3I).</li> </ul> <p>Total 3125</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 939 – Evaluate moving target indicator (MTI) and synthetic aperture radar (SAR) technologies and complete payload preliminary design trade-offs for compact tactical aerial vehicle applications.</li> <li>• 16 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 955</p> <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3863 – Complete evaluation and component/module testing of affordable MTI/SAR radar technologies, and initiate design and development of radar technology demonstrator for application to future tactical UAVs.</li> </ul> <p>Total 3863</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5762 – Complete fabrication and module testing of compact, affordable radar assembly and initiate integration onto aircraft for test and demonstration.</li> <li>– Initiate design of advanced waveform and transmitter modules for ultra wide band radar for foliage and ground penetration.</li> </ul> <p>Total 5762</p> |                   |                     |                     |   |                     |                     |                           |                        |                     |            |
| Project D243  |                   |                     | Page 5 of 8 Pages   |   |                     |                     | Exhibit R-2 (PE 0603772A) |                        |                     |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>       |  |                |                               | DATE<br><b>February 1997</b> |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b> | <b>PE NUMBER AND TITLE</b><br><b>0603772A Advanced Tactical Computer Science<br/>and Sensor Technology</b> |                | <b>PROJECT</b><br><b>D243</b> |                              |
| <b><u>B. Project Change Summary</u></b>                              |  |                |                               |                              |
|  | <u>FY 1996</u>   | <u>FY 1997</u> | <u>FY 1998</u>                | <u>FY 1999</u>               |
| FY 1997 President's Budget   | 3200   | 975            | 3862                          | 5768                         |
| Appropriated Value   | 3290   | 955            |                               |                              |
| Adjustments to Appropriated Value                                    | -165   |                |                               |                              |
| FY1998 Pres Bud Request  | 3125   | 955            | 3863                          | 5762                         |
|  |  |                |                               |                              |
| Project D243   | Page 6 of 8 Pages  |                |                               | Exhibit R-2 (PE 0603772A)    |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>   |                   |                     |                          |  |                     |                     |                           | DATE<br><b>February 1997</b> |                               |            |
| <b>BUDGET ACTIVITY</b><br><b>3 - Advanced Technology Development</b>   |                   |                     |                          | <b>PE NUMBER AND TITLE</b><br><b>0603772A Advanced Tactical Computer Science</b> |                     |                     |                           |                              | <b>PROJECT</b><br><b>D281</b> |            |
|  |                   |                     |                          | <b>and Sensor Technology</b>   |                     |                     |                           |                              |                               |            |
| <i>COST (In Thousands)</i>   | FY 1996<br>Actual | FY 1997<br>Estimate | FY 1998<br>Estimate      | FY 1999<br>Estimate  | FY 2000<br>Estimate | FY 2001<br>Estimate | FY 2002<br>Estimate       | FY 2003<br>Estimate          | Cost to<br>Complete           | Total Cost |
| D281 Ground Combat Identification Demonstrations   | 6624              | 6897                | 3362                     | 0  | 0                   | 0                   | 0                         | 0                            | 0                             | 25865      |
| <p><b>A. <u>Mission Description and Justification:</u></b> 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 identification (ID) and situational awareness (SA) capabilities into the digitized, Joint battlefield environment and architecture. Selection of candidate approaches for technical and operational field evaluation are made based on results of architecture investigations for the combined arms battlefield. This advanced development serves as the foundation for the Joint advanced concept technology demonstration (ACTD) for air-to-ground and ground-to-ground combat ID. The ACTD will utilize the Army's Task Force XXI digitized brigade advanced warfighting experiment (AWE) and all services combat identification evaluation team (ASCIET) field experiments as a means to assess operational utility of these new capabilities. Information derived from these field experiments will support specification of follow-on engineering and manufacturing development (EMD) efforts.</p> <p><b>FY 1996 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3000 – Completed tradeoff experiments and analyses for technology options to improve the target ID capability for battlefield combat identification system (BCIS)             <ul style="list-style-type: none"> <li>– Completed experimental analysis of digital data link performance for prototype enhancements to BCIS and completed software design modifications and integration in preparation for Task Force XXI AWE.</li> </ul> </li> <li>• 3624 – Completed technical field experiments with prototype air-to-ground combat identification (CI) system alternatives, selected and completed development of technologies to be demonstrated in Task Force XXI AWE and ASCIET exercises, and initiated training of operational personnel.             <ul style="list-style-type: none"> <li>– Conducted virtual simulation of BCIS digital data link and air-to-ground CI systems alternatives.</li> </ul> </li> </ul> <p>Total 6624</p> <p><b>FY 1997 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 6738 – Conduct Joint combat identification ACTD. Complete user training on enhanced BCIS and air-to-ground CI equipment, support Task Force XXI AWE and ASCIET field exercises, and assist in data analysis.             <ul style="list-style-type: none"> <li>– Integrate advanced CI hardware/software with advanced target acquisition (2nd GEN FLIR) and battlefield digitization equipment (digital appliqué) from the Army horizontal technology integration (HTI) and science and technology base programs, and perform initial technical experiments.</li> </ul> </li> <li>• 159 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.</li> </ul> <p>Total 6897</p> |                   |                     |                          |  |                     |                     |                           |                              |                               |            |
| Project D281   |                   |                     | <i>Page 7 of 8 Pages</i> |  |                     |                     | Exhibit R-2 (PE 0603772A) |                              |                               |            |

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| <b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>  |   | DATE<br><b>February 1997</b> |         |         |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
|---|---|------------------------------|---------|---------|---------|---------|---------|----------------------------|------|------|------|---|--------------------|------|------|--|--|-----------------------------------|------|--|--|--|-------------------------|------|------|------|---|
| BUDGET ACTIVITY<br><b>3 - Advanced Technology Development</b>   | PE NUMBER AND TITLE<br><b>0603772A Advanced Tactical Computer Science<br/>and Sensor Technology</b> |                              |         |         |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
|   |   | PROJECT<br><b>D281</b>       |         |         |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
| <p><b>FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 3362 – Extend FY 1997 situational awareness (SA) through sight field demonstration to include Enhanced Battlefield Combat Identification System (E-BCIS), appliqué and other acquisition and target ID systems.</li> <li>– Complete analysis of extended positional accuracy capabilities of system based E-BCIS and other systems.</li> </ul> <p>Total 3362</p> <p><b>FY 1999 Planned Program:</b> Program not funded in FY 99.</p> <p><b>B. <u>Project Change Summary</u></b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1996</th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1997</th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1998</th> <th style="text-align: center; border-bottom: 1px solid black;">FY 1999</th> </tr> </thead> <tbody> <tr> <td>FY 1997 President's Budget</td> <td style="text-align: center;">6784</td> <td style="text-align: center;">7136</td> <td style="text-align: center;">3412</td> <td style="text-align: center;">0</td> </tr> <tr> <td>Appropriated Value</td> <td style="text-align: center;">6976</td> <td style="text-align: center;">6897</td> <td></td> <td></td> </tr> <tr> <td>Adjustments to Appropriated Value</td> <td style="text-align: center;">-352</td> <td></td> <td></td> <td></td> </tr> <tr> <td>FY1998 Pres Bud Request</td> <td style="text-align: center;">6624</td> <td style="text-align: center;">6897</td> <td style="text-align: center;">3362</td> <td style="text-align: center;">0</td> </tr> </tbody> </table> |   |                              |         | FY 1996 | FY 1997 | FY 1998 | FY 1999 | FY 1997 President's Budget | 6784 | 7136 | 3412 | 0 | Appropriated Value | 6976 | 6897 |  |  | Adjustments to Appropriated Value | -352 |  |  |  | FY1998 Pres Bud Request | 6624 | 6897 | 3362 | 0 |
|   | FY 1996   | FY 1997                      | FY 1998 | FY 1999 |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
| FY 1997 President's Budget  | 6784  | 7136                         | 3412    | 0       |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
| Appropriated Value  | 6976  | 6897                         |         |         |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
| Adjustments to Appropriated Value   | -352  |                              |         |         |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
| FY1998 Pres Bud Request   | 6624  | 6897                         | 3362    | 0       |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |
| Project D281  | <i>Page 8 of 8 Pages</i>  | Exhibit R-2 (PE 0603772A)    |         |         |         |         |         |                            |      |      |      |   |                    |      |      |  |  |                                   |      |  |  |  |                         |      |      |      |   |

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